**Coming—next month.** The special August number devoted to the great Bunker Hill & Sullivan enterprise, as it is today. More about it on page 27.

▼

**Oglethorpe University** has undertaken to seal a complete record of "our civilization" in a subterranean vault for 60 centuries for the benefit of posterity. The vault is built in part of stainless steel. The Pharaohs also were given to burying for the future, but their caches for the most part fell to thieves. How to prevent some similar mishap would seem to be Oglethorpe's great problem—how to insure discovery of the record 6,000 years from now, without inviting the unregenerate looter of some distant generation.

▼

**Less ambitious** is the tea market-expansion bureau in London which has recently put away in a safe place a package of English tea marked "Not to be opened until Jan. 10, 2039," in order to show posterity what the Englishman of a century earlier drank. This coming from the *Aluminum News Letter*, one is not surprised to learn that the sample leaves were wrapped in parchment, then in aluminum foil, and then inclosed in a lead case—all by way of preserving the tea's flavor and bouquet.

▼

**Remember,** blasting caps are dangerous. Those who use them should take care that none fall into the hands of children, hundreds of whom are injured yearly in playing with them. These accidents reach a peak in July and August, according to the Institute of Makers of Explosives, at whose request we publish this reminder.

▼

**Italian Nickels.** Not exactly a wooden nickel, but something just as good, may be the thought behind the recent decree in Italy to replace nickel coins by "acmonital," a new stainless steel alloy developed by that country. Reports indicate that this is one of Italy's methods of conserving one of her strategic materials and she stands to save between five and six thousand tons of nickel. More than a nickel's worth.

▼

**The Sloan** mineral separator appears to be a device covered by United States Patent 1978726. A descriptive circular states that it is to the mining world what the cream separator is to the dairymen.

▼

**Water-wheel** capacity in world plants has risen from 23,000,000 hp. in 1920 to 64,000,000 at the end of 1938, according to the United States Geological Survey, an increase of almost 180 per cent. The United States is first in developed water power, with 17,949,000 hp. installed capacity; Canada is second, with 8,191,000. The Survey states, however, that in the countries having abundant water-power resources the electrical output of the wheels is greater per horsepower installed than in those whose resources are not so great.

H. C. PARMELEE
Editorial Director

# Engineering and Mining Journal

H. W. CLARKE
Vice-President

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## Contents for JULY 1939

Copyright 1939 McGraw-Hill Publishing Company, Inc.
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Editorials ..... 27
An Efficient Smelter Power Plant ..... 29
John B. Huttl
New Technique of Boring Overcomes Sampling Problems ..... 32
O. J. Parker, Jr.
Exploration? Or Is It Evaluation? ..... 39
J. H. Farrell
Newfoundland Ships Fluorspar ..... 42
C. K. Howse R. P. Fischer
Reclaiming a Shaft With a Stiff-leg Derrick ..... 46
R. S. Blitz
Open-pit Transport on the Mesabi Range—VI ..... 48
L. C. Moore
As Phelps Dodge Prepares to Mine its Clay Orebody at Morenci, Arizona ..... 50
Photographs
How a Grinding Circuit Was Improved ..... 52
L. D. Gilbert
Useful Operating Ideas ..... 54
Summary of the Markets ..... 56
Personal Items, Obituaries, Letters ..... 59
News of the Industry ..... 61
Book Reviews, Publications Received ..... 83
Equipment News ..... 85

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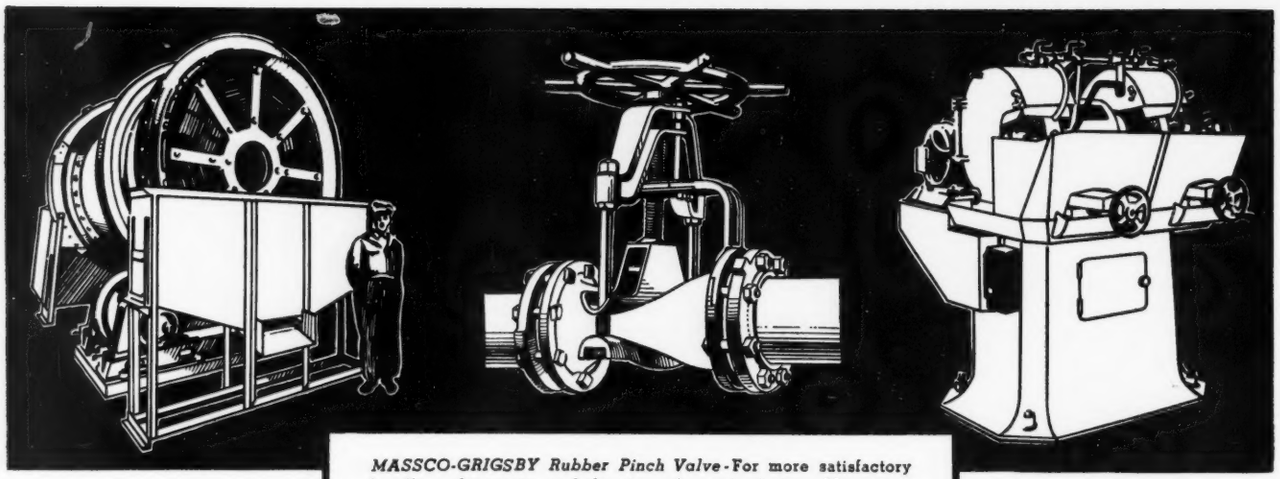

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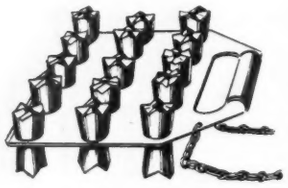

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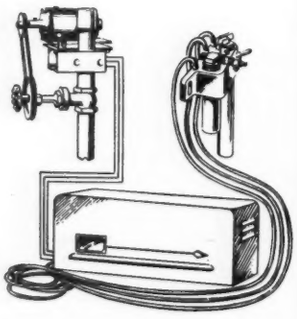

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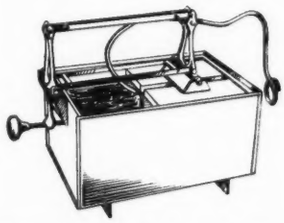

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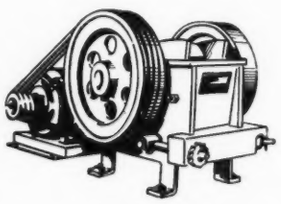

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Volume 140 Number 7

JULY, 1939

## A Great Enterprise

IN SELECTING the famous Bunker Hill and Sullivan enterprise as the subject to which its special August number will be devoted, *Engineering & Mining Journal* could have made no happier choice. Well known as it is, this mining company of the Coeur d'Alenes of northern Idaho deserves even greater recognition by reason of its splendid record of production of lead-zinc-silver ore, stretching unbroken now for more than half a century; its technical accomplishments; the diversity of its work, including mining and concentration, lead smelting and refining, electrolytic zinc and byproduct operations, and the numerous related activities; and its service to the region in which it is situated as a provider of not only employment but of facilities for treating custom ores.

The expansion witnessed since the first claims were located in 1885 has been achieved without outside financing, the earnings of the parent mine providing all needed funds. Likewise, in the evolution of the company's technical operations, the local staff, through research and invention, has always been an important contributor to the progress made. The story of these achievements is told in full and brought up to date in the group of articles prepared by the company's department heads and technicians for the August issue, all of which has been made possible through the courtesy of Mr. Stanly A. Easton, president and general manager of the company.

## Silver Legislation

THE SENATE'S ACTION on June 26 in respect to the President's special monetary powers that were to expire with the end of the fiscal year was a major surprise. A desire to end the Chief Executive's authority over the dollar would have been readily understandable; likewise a wish to stop the further purchases of foreign silver or to pay the producers of domestic silver even more than they had been getting, had each of these been considered by itself. But to vote, as the Senate did, for all of these changes at the same time was somewhat breath-taking. Never has politics made stranger bedfellows and so suddenly! The coalition of normally opposed groups that permitted it broke up, however, when the silver members voted on July 5 to accept the conference report, leaving the President's monetary powers unchanged, but setting 71.11 c. as a mandatory price hereafter for newly mined domestic silver, and authorizing the continuance of purchases of foreign silver.

For producers of the precious metals the situation was naturally disturbing. Any question linked with the future of gold and its relation to the dollar involves a speculation difficult to settle. Moreover, important American mining companies are among the miners of foreign silver, particularly in Mexico, and they would suffer heavily were the principal buyer of the metal to withdraw suddenly from the market. It is unfortunate that matters so important to the mining industry should be the football of politics, national and international.

## In the Metal Markets

TRADE in copper, lead and zinc in the United States during the first half of the year fell short of expectations, less because of volume than of the prevailing low prices. Early in 1939 the outlook for business was rather favorable: war fears, it seemed, would play a less conspicuous part in world affairs, and better relations between business and the Administration were anticipated. Both hopes faded before the year was three months old. A dispute between labor factions in the bituminous mines added to the difficulties. In brief, management passed through another trying period.

Copper abroad presented a healthy picture, but the price could not be lifted because of the constant threat of larger offerings from this side of the water. Producers in this country held firmly to the belief that buying in volume would begin as soon as certain factors not directly connected with the market place—such as war scares and politics—would permit planning for longer periods than from day to day. For a long time shading of the price named by the large mine operators was possible through transactions tied to Commodity Exchange contracts. Not until consumers began to take up their options was the extent of this "outside" business known. Price confusion was general until early May, when the producers' quotation dropped to 10c., Connecticut Valley basis, clearing the atmosphere, and as a result buying soon ex-

panded. However, before the price structure can be steadied, here as well as abroad, production will have to be cut to the point where it more nearly equals consumers' current needs.

As for lead, to obtain a more remunerative price the industry in this country must wait on London. Unlike copper, the real source of the metal's weakness has been the foreign situation. Constant pressure of British Empire lead on the now narrow London market has kept the price abroad down to about 3c. per pound for months. As the second quarter ended, that market appeared to become more stable, enabling producers on this side to raise their price 10 points to 4.85c., New York. Had London permitted, the price might easily have been moved upward to 5c. or more, consumption and production here having held a fairly even pace since the beginning of the year.

Zinc producers have suffered far more than the copper and lead divisions of the domestic mining industry, owing to the low price forced upon them by the tariff reduction that became effective Jan. 1. Throughout the six-months' period the price of Prime Western metal remained unchanged at 4½c., St. Louis, with scant comfort from Washington that something might be done to help the situation. The Bureau of Mines has recently gone on record with the statement that "the 20 per cent reduction in the import duty on zinc, resulting from the Canadian Trade Agreement signed Nov. 17, 1938, aggravated the already unfavorable competitive position of the domestic zinc industry." We still believe that the Department of State acted unwisely in tampering with the zinc duty.

July finds the trend of general business activity pointed upward. Building operations are expanding, largely under Federal aid, and lower inventories are bringing buyers into the market for raw materials more frequently. London confidently expects a mild boom, owing to intensive rearmament activity, and this may remove the pressure on metal prices from that quarter. The immediate outlook is encouraging.

## Geology on the Air

CONGRATULATIONS ARE DUE the Geological Society of America for the series of talks by members that was recently broadcast from two of the leading stations in this country. This well-directed effort to inform the public in an interesting way as to the practical and cultural value of geology should bear good fruit and can be repeated to the advantage of the profession that the G.S.A. represents.

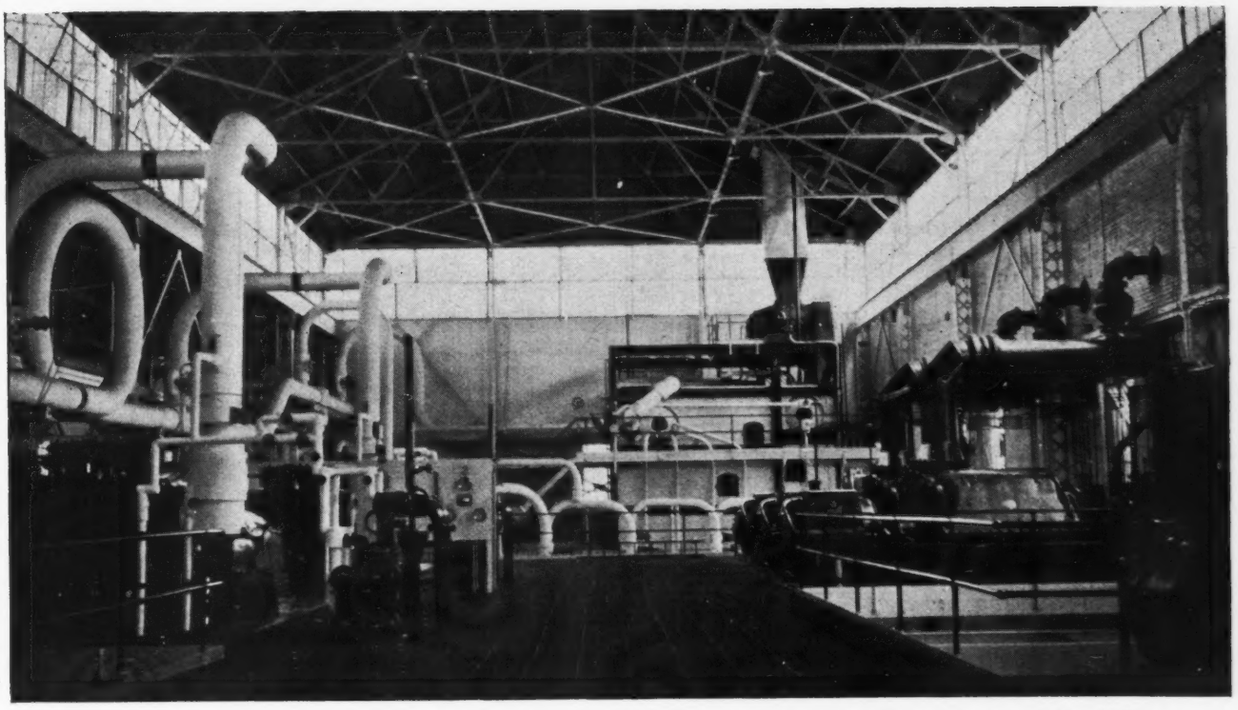
The service rendered modern civilization by the geologist was well brought out in the talk by Dr. Charles P. Berkey, the Society's secretary, who emphasized the ever-increasing need for the perfect adjustment of great engineering structures to the natural physical conditions surrounding them and affecting their success. Cooperation between geologist and engineer, though not wholly new, said Dr. Berkey, is "vastly different from what it used to be in range of responsibility and affectiveness," and the geologist is now recognized on important projects as the rule rather than the exception. Geology has become immensely practical.

With the ample funds at its disposal, thanks to the munificent bequest of the late R. A. Penrose, Jr., the Society is, as Dr. W. C. Mendenhall, of the United States Geological Survey, said at the Cincinnati meeting in 1936, "the great geologic foundation" and "is in position to foster any desirable project in geology anywhere on this continent." It will surely not stay its efforts, so well begun, to enhance the position of the geological profession still further in public esteem.

## Suspension Ends

AS THE ASSESSMENT WORK year drew to its close on July 1, at noon, without further suspension by Congress of the provision of the Mining Law calling for the performance of $100 worth of work on each unpatented claim in each twelve months, there was surely an activity such as has been unnoticed during the past seven years in various areas throughout the Western States. Reports indicate that many a man in recent weeks has found welcome work in last-minute employment given by claim owners who wished to remain in the legal possession of their ground and who foresaw there was little hope of further leniency. Still others there must have been who were keeping a watchful eye on claims they had in mind to locate for themselves as soon as the legal deadline was past and the way was open. At least one old prospector we know of declined an otherwise attractive job in order to leave himself free to carry out a similar purpose. Within a few days of the end of June a measure was passed by Congress granting two months' extension of the time for performing the necessary work. This act, it should be noted, leaves the basic situation unchanged. The work must be done. The seven-year confusion-breeding irregularity caused by suspension is at an end.

To some former claim owners, honest in intent but hard up, the refusal of Congress to grant further suspension works an actual hardship. By and large, however, the country will benefit. Seven years of leniency is quite enough.



Interior of new power house. Right, three turbo-blowers. Left, two turbo-generators. In the rear, the stand-by boiler

# An Efficient Smelter Power Plant

*Units of the new waste-heat installation of the Phelps Dodge Corporation at Douglas, Arizona, were designed and the equipment was selected with regard to reliability, flexibility and safety*

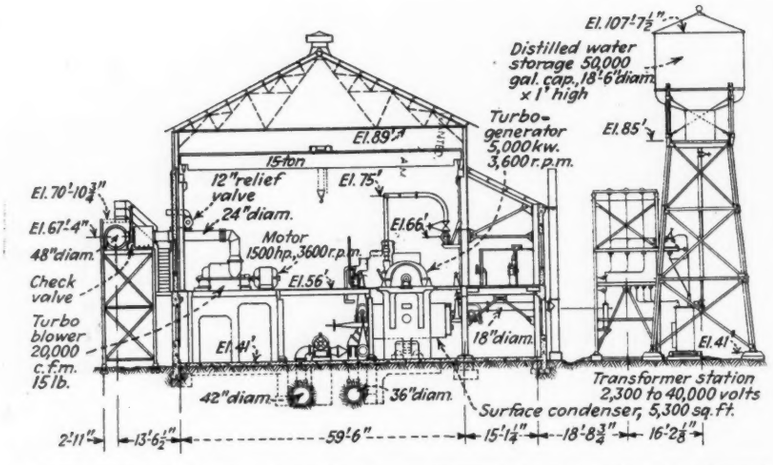
**John B. Huttl**
*Assistant Editor*

OPERATING FACILITIES have been substantially improved by the Phelps Dodge Corporation since 1935, and in some instances potential capacities have been raised by increasing the size of units or increasing the efficiency of equipment at its different properties in Arizona. What has been accomplished under this campaign at the company's Douglas smelter, situated a short distance west of the town of Douglas, Ariz., was brought home to me. when on a recent visit I was permitted to inspect the new waste-heat boilers in the reverberatory department and the high-pressure power plant placed in operation early this year. All details incident to the design, layout, and construction of these units were handled by the engineering staff of the company, with factors such as reliability, flexibility, and safety governing plant design and selection of equipment.

At the power house many devices controlling the divers power- and air-generating units are entirely automatic, and recording and graphic meters installed at strategic points give complete data on air, power, and steam operations and help maintain a proper and constant balance between the power house and the boilers about 500 ft. distant. In selecting multiple-power and air-generating units, the designers have provided flexibility of operation so often required at smelters and kindred plants. For instance, one waste-heat boiler, power-generating unit with auxiliaries, and turbo blowers constitute a complete power unit which can be operated singly when smelter operations are on a reduced basis and in parallel with other units when there is a full power demand. In addition, there is a standby boiler unit in the power house ready to pick up the load at a moment's notice in the event of interruption to the waste-heat boilers.

Generous spaces and high ceilings in the interior of the power house building make all machinery easily accessible, insure safe and clean operations, and provide pleasant working conditions during the fairly hot summer months. The power plant produces alternating current for driving conveyors, crushing units, air compressors, and other motors, direct current for slag and calcine haulage, cranes, converter and anode vessel drives, and ore feeders, and high- and low-pressure air. Three 44,000-volt circuits are available between Douglas and Bisbee for transmitting surplus power to the mines 25 miles away.

The power house building proper is a concrete and brick structure 192 ft. long and 74 ft. 7¼ in. wide (inside). A cross-section of the power house is shown in Fig. 1. Two separate floors are available in the building—namely, an operating floor on which are installed the main power and air-generating units, switchboard, and motor generator sets, and the ground floor or basement 15 ft. below, containing the auxiliaries. The operating floor is covered with steel grillage




**A cross section of the power house showing the arrangement of the principal equipment**

through which the auxiliary units below can be constantly observed. Basement floors and walls are covered with enamel paint, and the cleanliness evident there is impressive.

The main power equipment installed on the operating floor consists of two G. E. 15-stage, 3,600-r.p.m. steam turbines operating at 340-lb. pressure and direct-connected to 5,000-kw., 2,300-volt, three-phase, 60 cycle generators producing alternating current; one I-R and two Allis-Chalmers turbo blowers, each delivering 20,000 cu.ft. of low-pressure converter air per minute; a Sullivan angle-compound air compressor providing air at 90-lb. pressure; one Westinghouse d.c., 600-kw. flywheel motor-generator set and two Allis-Chalmers d.c., 300-kw. generator sets with synchronous motors; a 75-kw. motor-driven exciter; telephone booth; instrument panel; two air ejectors; and the main switch board made by the Square D Company, of Los Angeles. Switches, instruments, and other control equipment are of G. E., Westinghouse, and Allis-Chalmers make.

On the eastern end of the power house is the 662-hp. Erie City Iron Works standby boiler unit mentioned previously, which operates at 300 per cent rating. It is fired with natural gas through five Nemec Combustion Engineers burners. A fan on top of the boiler induces combustion air and discharges the exit gases into the stack. With steam pressure controlling both the burners and air shutters, operation of the boiler is completely automatic. Efficiency rating at full load averages 76 per cent. The basement houses auxiliaries such as the surface condensers connected to the two turbines; three Worthington feed-water pumps, two of which are steam driven; the plant deaërating feed water; and the five-stage evaporator plant producing distilled water for the boilers. An elevated steel tank of 30,000 gal. capacity outside the north wall of the power house is available for the convenient storage of distilled water.

Average steam consumption of each turbine at full load is 11.65 lb. per kilowatt-hour, with a vacuum (absolute pressure) of 1.25 Hg, which is equivalent to 13,000 B.t.u. per kilowatt-hour, based on total heat transferred to steam. Each waste-heat boiler produces sufficient steam to drive one turbine. Two 5,700-g.p.m. centrifugal pumps (one standby unit) circulate the condenser water through cast-iron and wood-stave pipes to a cooling pond measuring 210x270 ft., where chlorine gas is introduced to prevent algae growth. Distilled water for boiler feed-water make up is produced in a plant consisting of five evaporator units operated with high-pressure steam, of which any one may be taken out of service without stopping production. Hourly production of the plant is about 5,800 lb. of distilled water, which equals 4.41 lb. for each pound of steam used. Before going to the boilers, the feed water is treated in two stages at the deaërating plant in the following manner: (1) It is heated to boiling to eliminate oxygen in a deaërating heater utilizing steam extracted from the turbines at 2-lb. gage pressure, and (2) the temperature of the deaërated water is subsequently raised to 280 deg. F. in a closed heater by means of steam bled from the turbines at 60-lb. gage pressure.

The three electric-driven turbo blowers discharge the air at 14-lb. pressure into a 48-in. steel pipe line leading to the converter department, where air comsumption is measured by indicating and recording meters installed at each converter. In the power house the total air volume going through the main is measured by means of an orifice meter. Average air production per kilowatt-hour is 1,165 cu.ft., at 12.8 lb. barometric pressure and 100 deg. F.

High-pressure air for the different plant operations is produced by the 2,700-cu.ft. Sullivan compressor mentioned previously. The 600-kw. motor-generator set and the two 300-kw. reserve units furnish all the direct current needed throughout the smelter. Should a power failure render inactive both the motor-generator sets and blowers, the flywheel on the large unit could furnish power for at least 2 min., sufficient time to turn down the converters and anode furnaces, and move cranes.

The switchboard on the operating floor contains separate panels for operating the power-house machinery and distribution lines. Equipment serving each circuit includes recording and indicating meters, overload circuit breakers, and lightning arresters.

Outside of the north wall of the power house is a substation consisting of six Westinghouse transformers which step up the voltage of the current produced from 2,300 to 44,000 for transmission to the Copper Queen mines, at Bisbee. Current used in the different departments of the smelter is reduced by transformers to 440 volts.

Normal steam requirements of the power plant are obtained exclusively from two waste-heat boilers fired by the hot exit gases of reverberatory furnaces, each furnace measuring on the inside 107x26 ft. This furnace-boiler layout is unique in that the waste-heat boiler is installed directly

### Table I—Furnace-Boiler Plant

| | |
|---|---|
| Tons charge per furnace day (aver.) | 1,000 |
| Million B.t.u. fired per ton charge | 3 00 |
| Waste heat recovery, per cent | 52 00 |
| Feed water—lb. per hr. | 60,865 |
| Feed water—temperature, deg. F. | 274 |
| Net steam generated—lb. per hr. | 59,421 |
| Steam temperature, deg. F. | 663 |
| Steam pressure, lb. per sq. in. gage | 346 |
| B. hp. developed | 1,955 |
| Per cent rating | 76 |
| Inlet gas temperature, deg. F. | 2,250 |
| Exit gas temperature, deg. F. | 516 |
| Actual evaporation, lb. per 1,000 B.t.u. | 0.471 |
| Equivalent evaporation, lb. per 1,000 B.t.u. | 0 535 |
| Per cent fuel to steam | 51.88 |

### Table II—Power House

| | |
|---|---|
| **Turbines** | |
| Steam to turbines, lb. per hr. (ea) | 59,000 |
| Steam pressure, lb. per sq. in. gage | 340 |
| Steam temperature, deg. F. | 660 |
| Kw.-hr. generated (average) | 4,825 |
| Lb. steam per kw.-hr. (incl. impaired vacuum) | 12 23 |
| Condenser inlet temperature, deg. F. | 83 |
| Condenser outlet temperature, deg. F. | 101 |
| **Converter Blowers.** | |
| Kw.-hr. used per day (two units operating) | 57,416 |
| Air produced per day, million cu. ft. | 66,890 |
| Cu. ft. per kw--hr. | 1,165 |
| Inlet air temperature, deg. F. | 83 |
| Discharge air temperature, deg. F. | 245 |
| Discharge pressure, lb. per sq. in. | 13.8 |
| **Average Loads** | |
| A. c. power, average week day hourly load, kw.-hr. | 11,830 |
| D. C. power, aver. hourly load | 150 |
| High-pressure air, cu. ft. per min. | 1,540 |
| Water, gal. pumped per day | 1,665,000 |
| Natural gas used per day (total plant), million B.t.u. | 10,750 |

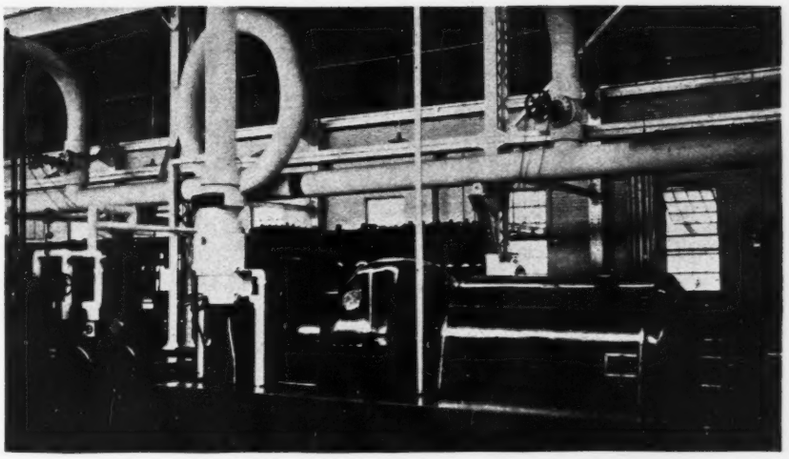
above the outlet of the furnace without dampers of any kind between the furnace and the boiler. Both boilers are of B. & W. make, and contain 25,680 sq.ft. of heating surface.

The reverberatory furnaces use natural gas as a fuel, with six high-pressure burners at the firing end, and the material treated consists chiefly of copper ore and roasted concentrates. Waste-heat recovery is about 52 per cent. The boilers are designed for 400-lb. pressure and 644 deg. F. steam temperature, with steam production per boiler amounting to some 60,000 lb. per hour.

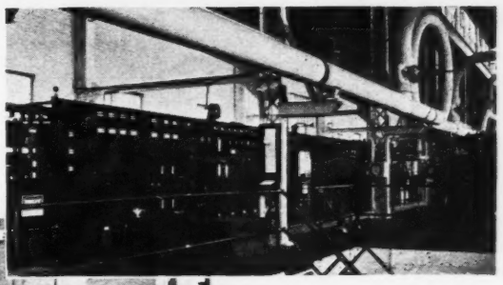
Boiler walls are constructed of firebrick and vary in thickness from 18 to 22½ in. Superheaters are of the pendant type. The sloping wall between the furnace arch and the boiler wall on one boiler is of silica brick construction; on the other boiler a suspended wall with firebrick is used. Each boiler is 60 tubes wide and contains a slag screen front row of tubes. Soot blowers operated with superheated steam are available in all boiler passes, and two tiers of ten lancing doors are in the front wall of each boiler for use in cleaning the front rows of tubes with hand lances using compressed air. One boiler in addition has a row of six telescopic soot blowers above these doors, which use superheated steam. These serve to remove loose dust not yet sintered near the top of the tubes. The boiler outlet area is about 120 sq.ft., and the gases leaving the boiler pass through a short downtake and into a hopper-bottomed balloon flue to the 300-ft. stack.

Dust accumulated in the small hoppers back of the mud drum and from the balloon flue is removed weekly (about 8,000 lb. per boiler). Produced steam is sent to the power house through a 12-in. insulated pipe line.

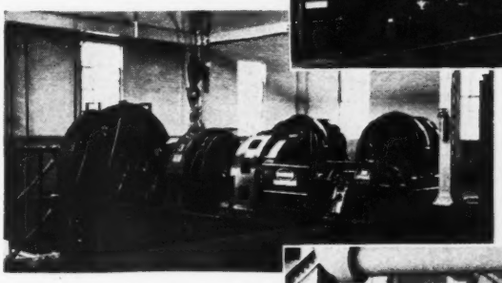
In conclusion, thanks are due to H. M. Lavender, general manager, for permission to publish the aforegoing article, and to Carl Cole, smelter superintendent, and L. L. McDaniel, general plant foreman, for the information contained therein. Mr. McDaniel is the author of a paper (A.I.M.E., T.P. 996) describing the plant presented at the Tucson, Ariz., meeting of the Institute in November, 1938.



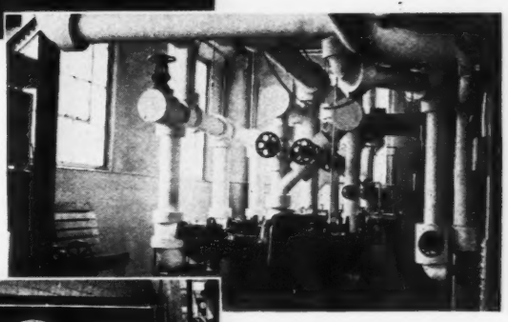
One of the two 5,000-kw. turbo-generators on the operating floor



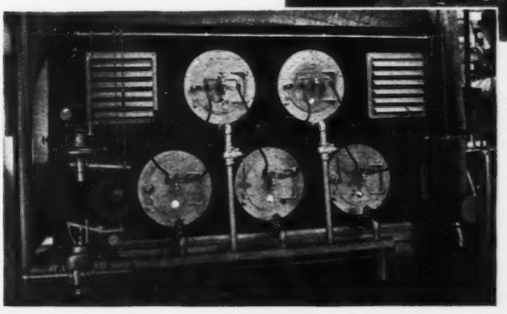
The main switch board



This d.c. 600-kw. flywheel motor-generator set and two d.c. 300-kw. sets with synchronous motors serve the plant



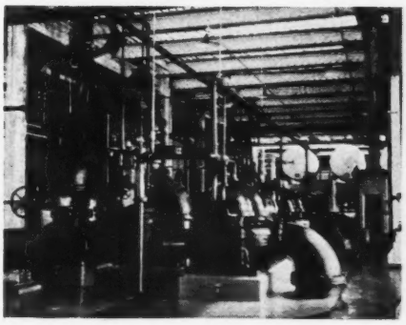
Three feed-water pumps, two of them steam-driven, supply the 662-hp. stand-by boiler unit

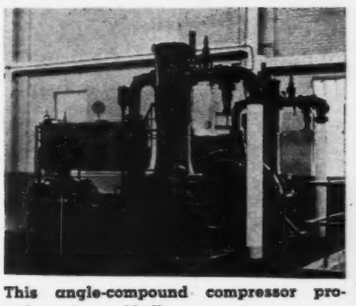


Five natural-gas burners fire the stand-by boiler unit. Both burners and air shutters are controlled by steam pressure

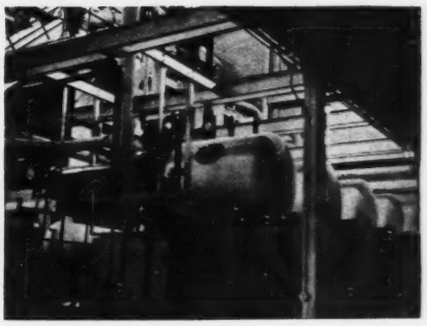
Five evaporator units operated with high-pressure steam produce distilled water for boiler feed-water make-up

The turbine condensers and pumps





This angle-compound compressor provides air at 90 lb. pressure



# A New Technique of Boring Overcomes Sampling Problems

*Methods employed on erratic low-grade deposit of oxidized gold ore give accurate results*

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*Ora Banda, Western Australia*

DURING the exploration and development of the large low-grade gold deposit in the property of the Ora Banda United Mines, Ltd., at Ora Banda, 42 miles northwest of Kalgoorlie, Western Australia, the sampling has provided an interesting problem to obtain a true indication of the average value of the ore. In the early stages, before the form and structure of the deposit and the mode of gold distribution had been sufficiently investigated, it was found that thorough channel and grab sampling gave considerably lower results than actual recovery by mill tests. Later, seven methods of sampling were used experimentally on the same ore, which was then sent to a stamp battery for treatment. But over a series of similar tests each method gave an "undersampling" error of varying degree, according to the individual method; and the provisional assay-plan factor calculated for the type of sampling closest approaching the battery return was too large for satisfactory use in the valuation of ore reserves.

After a detailed investigation had revealed the distribution of the gold to be in the main quasi-horizontal, a system of close boring was devised, using diamond-drilling machines with $2\frac{5}{8}$-in. diameter auger-type bits, for drilling nearly vertical holes upwards and dry from the workings on the two levels in the oxidized zone. This system largely overcame the sampling difficulties and is described in detail later. The method of boring proved successful and relatively inexpensive in this system, and it is thought that the technique may be applicable to similar deposits, particularly to the valuation and ascertainment of form and internal structure of certain deep-lying. comparatively soft, flat, sedimentary deposits, and also disseminated deposits of base metals or beds of commercial minerals, where a high concentration of bores would not be necessary.

*Lode Formation and Structure*—The ore deposit occurs in the porphyrite which forms the central portion of the Ora Banda field, and consists of the Gimlet South lode and a system of several "caunter" lodes as a hydrothermal replacement of the porphyrite along a line of conjugated fractures. The direction of the controlling structures is sensibly west-south-west, with a north dip of about 76 deg. Perceptible movement has occurred along the fracture line, dislocating the northwest jointing and causing fracturing sufficiently intense to produce a stockwork pattern.

The process of replacement extending over the disrupted zone has produced chemical and mineralogical changes of varying intensity. In some places on the hanging-wall and footwall sides of the Gimlet South lode the metasomatic rock is delineated by well-defined walls, probably planes of the main east-west fracturing, the impermeable gouge between the walls of the fractures arresting further outward diffusion of the hydrothermal solutions. Elsewhere a gradual passage from the most altered porphyrite, with all traces of the large feldspar crystals removed, to unmistakable country rock can be traced, resulting in great widths including slightly altered rock with the original form of the feldspar crystals retained but composed of secondary minerals.

The Gimlet South lode has at present been explored over a continuous length of 3,000 ft., with an average width of about 70 ft. The depth of oxidation varies from 270 to 410 ft. at the deepest known point, and development work has been largely confined to this zone above a horizon of 250 ft., from levels at depths of 140 to 250 ft.

From the work of previous operators it is known that a concentration of the gold occurs, at fairly regular intervals longitudinally, in tracts of high-grade ore continuous in a roughly vertical plane, varying in size and position in the lodes. In places these enrichments extend from footwall to hanging wall. Their general direction is predominantly about northwest, but they have been known to occur parallel to the strike of the lode. The thickness of the enriched areas, owing to replacement of the fissure walls, varies up to 8 ft. or more. Selective mining, however, is impossible. These occurrences are probably due to the extent of distortion of the pre-mineral fracturing, which is the controlling factor in the ore deposition in forming arterial paths at steep angles during the circulation of ascending solutions. The highest concentration of gold would thus be expected along these roughly vertical open ducts of greatest flowage; followed by the lesser fissures and shear planes at flatter angles, resulting from the same dynamic activity, the tenor of the ore declining with diminishing impregnation—mainly horizontal—as the distance of diffusion from the guiding fissures increased. However, regarded quantitatively, the greater deposition of the gold is in the massif of the lodes and is in the main horizontal.

*The Sampling Problem and Applied Methods*—Before a better understanding of the mode of gold distribution was attained, it was found after sending bulk-sample parcels of ore from development openings to a neighboring battery for checking the reliability of channel and grab samples, that invariably the battery returns were considerably higher than the value indicated by the development sampling.

In the case of crosscuts the channel samples were taken horizontally from both sides, 2 ft. above the sill, in 5-ft. sections and of the order of 4 in. wide by 1 in. deep, giving about 4 lb. per foot. Diagonal or other alignments of the grooves had no effect on the divergence mentioned.

With the idea that an area sample of the 5-ft. sections, instead of the narrow groove, would give results more in reconciliation with actual recovery, a steel claw (Fig. 1) was made for the purpose of stripping the sides of crosscuts in the oxidized ground. In a crosscut 7 ft. high each section had an area of about 7x5 ft., which was raked to a depth of about $\frac{3}{8}$ in., giving about one cubic foot of the ore. The sample weighed about 150 lb. On the 250-ft. level, where the claw could not be used effectively owing to the harder nature of the ore, a method of chipping was substituted. A similar area was marked off and a chip taken at regular intervals of 6 in. over the area, by moil and hammer.

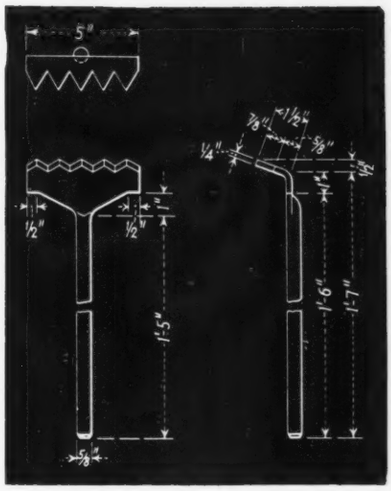



**Fig. 1. Steel claw used for taking area samples by raking the sides of crosscuts in 5-ft. sections**

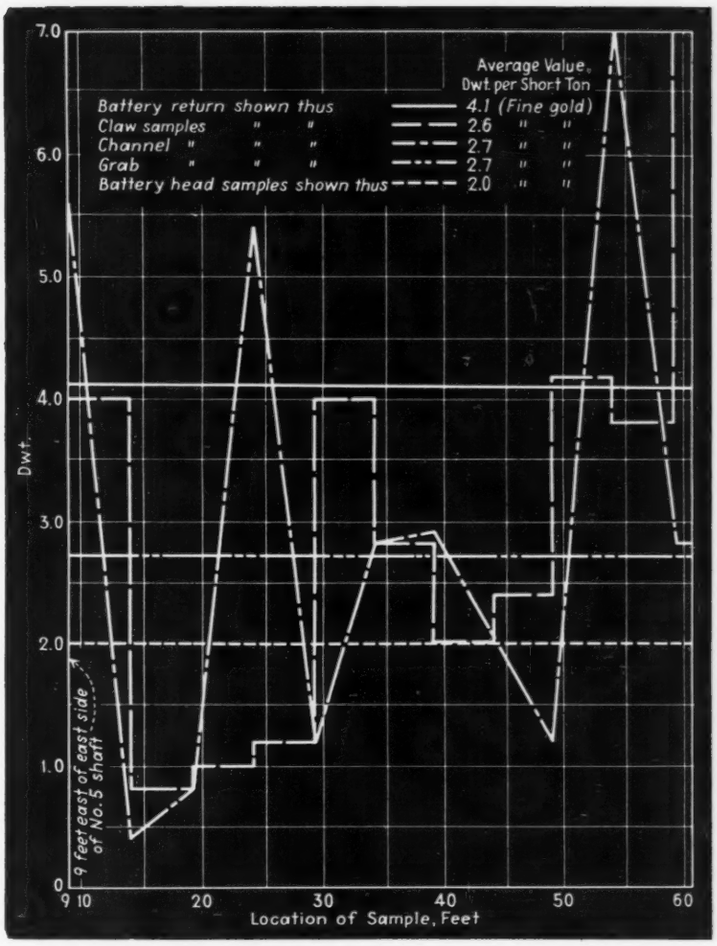

Average Value, Dwt per Short Ton
Battery return shown thus — 4.1 (Fine gold)
Claw samples " " — 2.6 " "
Channel " " " — 2.7 " "
Grab " " " — 2.7 " "
Battery head samples shown thus — 2.0 " "
Dwt.
9 feet east of east side of No. 5 shaft
Location of Sample, Feet

**Fig. 2. Comparative graph showing assay results of the various methods of sampling and the battery return, for one of the tests described**

Unfortunately, a bulk-sampling plant to handle all the ore broken in development, or a small pilot plant, was not installed. But as a substitute a five-head stamp battery on the property was reconditioned and used for testing parcels of ore from the development openings, of 50 tons or larger, against various methods of sampling. The purpose was also to disclose any constant error in the practicable methods, for the determination of a corrective factor applicable to further exposures, provided the nature of the ore remained reasonably the same.

The tests were carried out chiefly on ore from crosscuts, on both the 140- and 250-ft. levels. In the old workings on the higher level a crosscut was first thoroughly channel-sampled and claw-sampled on both sides. The sides were then uniformly stripped to give the desired tonnage for the battery, and the broken ore, which is friable, was systematically grab-sampled in the crosscut. After the mixing received from the handling underground and dumping, the ore was sampled again on the surface at the shaft bin during the loading of the truck taking the ore to the battery. Grab samples were again taken at the battery head bin after the further mixing involved in transportation and dumping. Test parcels from current development headings were sampled in a similar manner.

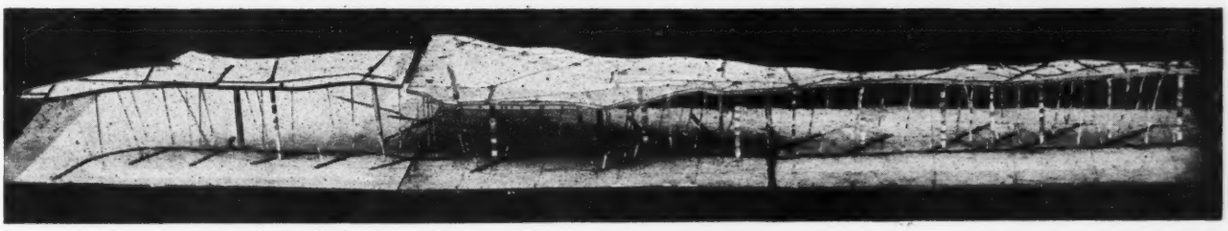
Battery returns were given by combining the gold recovery by amalgamation with the gold content remaining in the tailing, determined by assay. The tailing was sampled by the turbine-type automatic sampler adopted by the Western Australian Government Batteries, and also by another method as a check.

The individual results of these types of sampling, including the battery return, were plotted as a comparative graph for each test, as shown in Fig. 2; also tabulated in series for analysis and determination of a corrective factor for a practical method of sampling.

In 24 of the 30 tests completed, embracing 1,900 tons, the battery returns were considerably higher than all other forms of sampling. The corrective factor calculated for any one method was too large to be satisfactory, but the claw method, which could be used throughout the tests on the 140-ft. level, gave consistently the closest approach to head value.

*The Inherent Error in Sampling*—At this stage an independent and detailed investigation into the apparent inherent error in sampling was made by M. V. Weatherall, mining geologist, of Kalgoorlie. After deciding upon a method whereby the results of check sampling could be used to determine the mean error in sampling, independently of reference to the battery tests or reference to the company's sampling, a large number of locations, in drives and crosscuts, were selected where the mine sampling showed low values and medium-grade ore. At each of these places four samples were taken with maximum care by the claw method over the same area, each to a depth of about ¼ in.

**Fig. 3. Skeleton model of two levels constructed for the purpose of laying out part of the boring program**



The assay results from each member of a group of four showed some extraordinary discrepancies. These discrepancies were made use of to calculate the probable error in any one sample, for only one sample in routine practice is usually taken at one place.

The mathematical theory of probabilities and errors was applied to the discrepancies shown by each member of a set of four observations, (1) to determine the probable error in each individual and (2) to determine the mean probable error for ore of a given tenor, by combining all of the results as found in (1). For ore of low mean value, 27 sets of four samples, or a total of 108 samples or observations, were used for the 140-ft. level, and 14 sets of four samples, a total of 56, taken by the chip method, were used for the 250-ft. level. The object was to determine, in respect to this particular ore, whether a series of individual errors calculated from the observational data yielded a curve of similar form to the theoretical curve of errors and probabilities. If so, there would be a law that the experimental curve would obey, and the law could be deduced from the form of the curve. If such a law existed, it would support the validity of applying a corrective factor, and would suggest a factor compatible with that deduced from the battery tests, and this support would be obtained entirely independently of the battery tests.

The curves evolved definitely had the form of an error-curve, and the nearest coincident true mathematical curves were remarkably coincident with the experimental curves up to errors of magnitude of 120 per cent. Those vertical lines were found and drawn on the graph which would halve the areas under both sides of each curve, and from these the mean probable errors for each curve and the probability of each error were determined. The statistical testimony of the battery tests indicating a probability of 80 in 100 of an "undersampling" idiosyncrasy was then introduced. From an analysis of the results, provisional assay-plan factors, of a smaller order than hitherto, for low- and medium-grade ore up to 5 dwt., were determined for future use in the valuation of ore reserves.

The procedure was then to study the trend and distribution of gold values as indicated by the relationship of results of samples or sample groups in exposures in an equal degree in all three dimensions, by drives, crosscuts, and winzes. This was possible over a large section of the mine that had been completely opened up for mining. It was determined that the chief distribution of the gold was quasi-horizontal and sufficiently evident to preclude the use of exposures in the horizontal plane in valuation, which meant that the systems of calculation and sampling would have to be altered.

*The Boring Program*—It having been concluded that only exposures in a vertical plane were applicable to valuation, and the number of winzes in relation to the ore mass being inadequate for this purpose, giving a proportion of about one sample to 1,700 tons, a method of boring was devised to provide a more satisfactory proportion of accurate samples to the tonnage to be mined. After a few experimental holes, a program was laid out on skeleton models, scale 1 in. = 30 ft., such as illustrated in Fig. 3. Fine steel rods (bicycle spokes) were used to correspond to the proposed bores.

The lodestuff in the zone of oxidation consists of comparatively soft clayey material interspersed with relatively barren thin quartz veins. These veins are an irregular and minor constituent of the lodes and vary in thickness from a few millimetres of an inch to a few inches. The lodestuff becomes appreciably harder at the random horizon of the 250-ft. level.

Standard "H" Sullivan diamond drills were employed, except that the gearing was altered to increase the feed rate of the rods—size E—from 400 to 500 revolutions per inch. After experimenting with six different speeds, this was found to be the most satisfactory for general use. For drilling through quartz veins, however, the rate of feed was reduced to 400 revolutions per inch, normal for this model, by simply changing the gear wheels on the countershaft and feed nut.

The bores, spaced about 30 ft. apart, were drilled upwards from the back of the drives and crosscuts on the 250-ft. level to the 140-ft. level, and similarly from this level to the surface, at a minimum elevation of 75 deg.—the majority being at 82 deg. The weight of the drill rods, while adding another length, was carried by means of a "Stillson" wrench supported on a frame of $2\frac{1}{2}$x$\frac{1}{2}$-in. flat iron bolted to the side of the drill trolley. The average length of the bores was 110 ft., and all drilling was done dry, using $2\frac{5}{8}$-in. diameter bits of the auger type, with air jets for cleaning the hole. The deflection of the bores even in the

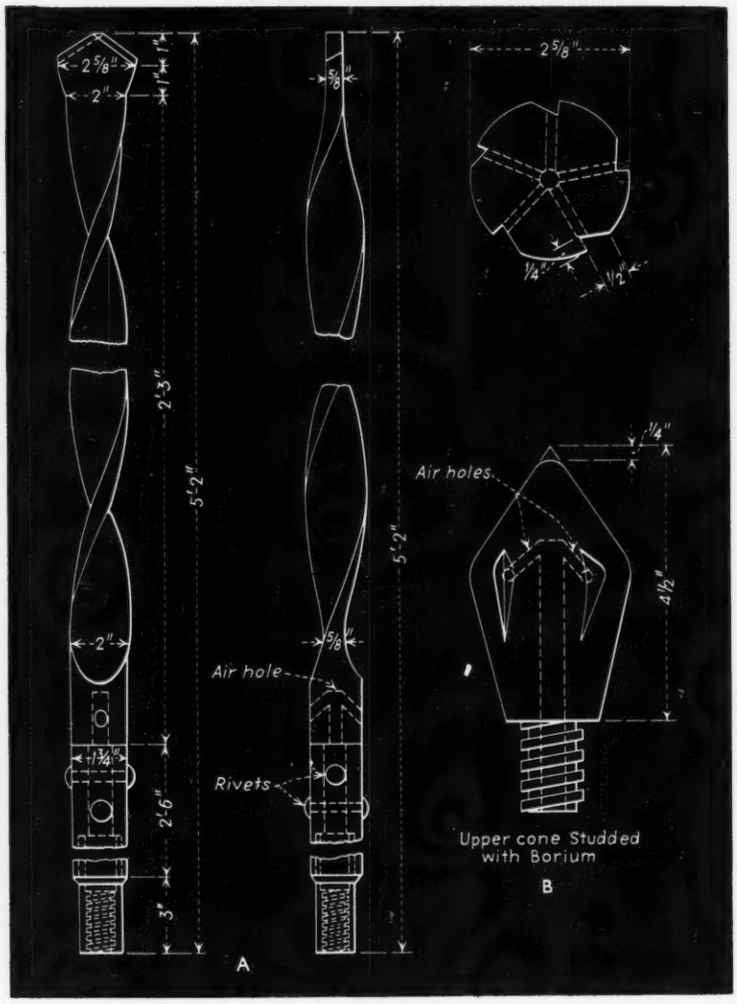



**Fig. 4. Bits developed that proved the most satisfactory (A) for the lode material, and (B) for penetrating the quartz veins**

longest holes of 135 ft. was negligible.

In allowable circumstances the primary advantage of drilling dry compared with wet methods—which for several reasons may not be considered satisfactory for valuation—is the accuracy of the sampling and the volume of the sample obtained. The problem is eliminated of maintaining a good recovery of combined sludge and core, probably necessitating the casing of the hole; the difficulties of correct interpretation of the respective assays for accurate results are not present; and the risk of the "salting" of one sample by another is greatly reduced. Other points in favor of dry drilling are the speed of drilling, aided by avoidance of regular withdrawal of the rods, and the relative cheapness of the method.

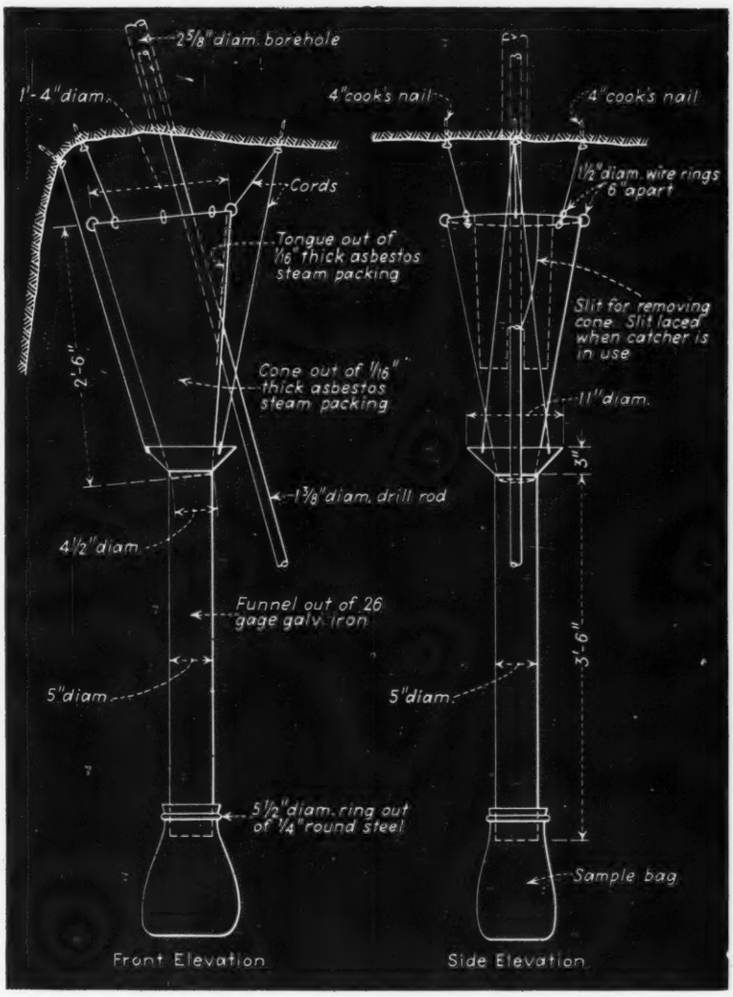



**Fig. 5. Sample catcher contrived to collect and bag the cuttings from the bit**

Bits of several designs were tried experimentally, including modifications of the fishtail and saw-tooth types for the lode material, tipped with stellite; and various forms, set with borium, for the quartz veins. Those of the fishtail type were entirely unsatisfactory owing to frequent breaking of the stellite caused by the jerky rotation and the wings of the bit catching. The catching of the wings also deviated the hole, and the same tendency applied to all forms of bits with flat tops, due to varying hardness in the area of the boring face. Finally, the bits shown in Fig. 4 were evolved and used throughout the program. The auger type (A) proved very satisfactory for practically all the boring, and capable of penetrating the smaller quartz veins. Originally these bits were tipped with stellite applied by welding, and the cutting edges finished by grinding. But later it was found that longer life without loss in drilling efficiency, and also cheaper and quicker sharpening, were attained by tipping with cast iron. New or worn bits were heated and dipped in molten cast iron and quenched immediately in water, and then gaged and roughly dressed by grinding. The cone-shaped bit (B), Fig. 4, studded with borium and provided with air jets for cooling, was occasionally used with reduced feed rate of the rods for boring through the larger quartz veins. It was not altogether successful, however, owing to overheating, and becoming embedded when softer ground was encountered. Both types had air jets in the shanks for cleaning the hole supplied by a separate air feed from the pipe line to the bottom of the rods.

The cuttings were caught in a special apparatus designed to eliminate loss, and bagged automatically. Details of this sample catcher are shown in Fig. 5. To avoid part of the sample falling over the drill, and to insure that all the cuttings were collected, the holes were bored at a maximum elevation of 82 deg.

The samples, taken in 5-ft. sections, each weighing about 25 lb., are at least equal to ideal channel samples of say 4 in. wide by 1 in. deep. Equitable volumes have been taken from all parts of a section, eliminating the human element; and uniform samples have been taken throughout the mass. That there was no "salting" of samples from contiguous sections was clearly evident from inspection of the borehole record sheets; and exemplified by the repeated occurrence of high-grade samples being followed by samples carrying only traces of gold. The absence of contamination was due largely to blowing out thoroughly each completed section with compressed air.

The drilling was carried out by Frank Weston & Company, diamond drilling contractors of Kalgoorlie, and a word of appreciation is due to this firm for its interest and invaluable cooperation in the necessary experimental work. Altogether, the program covered 12,660 ft. of drilling, in 155 boreholes, at an average cost of 56c. (2s. 9.8d) per foot—including 20 per cent profit to the contractors. The drilling cost of the full program was equivalent to 0.83c. (0.5d.) per ton of ore. The average drilling speed taken over the full period of the program was 17 ft. per drill per shift of 7 hours 12 minutes (Australian Workers Union Award 1937—underground workers), and includes experimental delays, stoppages, shifting and rigging drills, and related factors. This average would in all probability have been appreciably increased had the drill runners been paid by the drilling company on a contract footage basis instead of wages ($4.28 (21s. 6d.) per shift).

With the completion of the boring program, resulting in over 2,500 samples, the previous unacceptable proportion of one sample to 1,700 tons, given by shafts and winzes, was reduced to one sample of 25 lb. to 450 tons of ore to be mined. Apart from giving a more adequate number of observations for a satisfactory basis of valuation of the oxidized ore, the program provided a great deal of information of this abnormal deposit, impossible to obtain by other means, that will be invaluable during

mining operations and in reducing costs. Accordingly, it has been possible to map the orebodies within the lode channel from the disclosure of their shape and mass, assisted by the additional information of the mode of gold distribution. They can also be readily visualized in three dimensions when outlined on the models already mentioned.

*Preparation of Samples, Assaying, and Recording*—Written standardized instructions were issued for the various stages in the preparation of the samples, and also to the samplers at the drills. The routine is shown by the flowsheet, Fig. 6.

After the first weighing the sample was passed through a mounted screen running in angle-iron guides, and oscillated by hand; a hopper beneath the screen, attached to the guides, directed the screened material into the barrel of a mixer placed on a shelf below. This combined screen and hopper was designed for quick work, to reduce fatigue and to avoid double handling. The mixing was done in a Parker rotary mixer, Fig. 7, reducing the work to one man, two men being necessary on a mixing sheet in view of the size of the sample. The disadvantages of the mixing sheet were also avoided, such as slowness of operation, double handling, fatigue caused by bending, and the deterioration of the sample due to probable spill. By eliminating the human factor, a more thorough mixing of the sample was insured without the careful and conscientious work that is necessary with a mixing sheet to move continuously the centre of the sample. The six chief mixing motions are shown by arrows on the front and side elevations of Fig. 7.

The mixer was originally designed for the present use; precautions were taken in the construction against catchment of gold particles, and the apparatus is easily and quickly cleaned. From the screen already described, the barrel of the mixer, together with the lid with impellors attached, is placed in half bearings on the stand and slowly rotated. After about twenty revolutions, ample for thorough mixing, the lid is removed and the sample then passed direct from the barrel through the Jones samplers. The remainder of the routine in preparing the samples does not need special description and may be followed from the flowsheet.

The final pulps, ground to minus 100 mesh, the degree of division found necessary for accurate results, were sent to Kalgoorlie for independent assay. Duplicate pulps of all samples were filed for permanent reference. The assays were made in duplicate, with 2 assay-ton charges; a 20 per cent additional check was carried out with a different firing and throughout the program showed only surprisingly small variations. At intervals, as a check on the efficiency of the mixer and on the thoroughness of the preparation of the samples generally, random duplicate pulps from those retained for permanent reference were sent to the assayers with altered numbers. As an example of the variations, the following random comparisons are given—

| *Sample No.* | *Original Pulp,* Dwt. | *Duplicate Pulp,* Dwt. |
|---|---|---|
| 108 | 1.83 | 1.87 |
| 125 | 3.25 | 3.25 |
| 141 | 4.87 | 4.87 |
| 118 | 6.04 | 6.04 |

Of a higher order—

| | | |
|---|---|---|
| 2,378 | 31.50 | 31.95 |
| 824 | 42.91 | 42.79 |
| 2,379 | 59.04 | 59.50 |
| 530 | 99.16 | 99.37 |

A log of the drilling; details of likely importance of each sample, recorded by the samplers at the drills and during the preparation; the results of a physical test made on the pulp for differentiation between lode material and mullock; and the assay value, were entered on record sheets for each bore.

*Methods of Computation*—The assay result of each sample, and the results of the physical tests, were transferred from the record sheets, by a color index, to the respective bores on the skeleton models for investigation into the possibility of assay contours. As anticipated, these were found impossible to construct when analyzing the completed work in this form. Contiguous samples of sensibly equal value were then grouped in each bore, and colored appropriately, for the purpose of determining the existence of zones of a given tenor. But owing to lack of coordination between these exposures of similar value in adjacent bores—regarded from all angles of dip, pitch, and strike—it was found that such zones did not occur; and in cases where continuity could be made, there was not reasonable persistence in length to warrant the assumption. Notwithstanding this, it was clear that the distribution of the gold is in the main horizontal, proofs of which were advanced at the time. This feature is also substantiated by the improvement in grade shown by the winzes and bores over the levels; the vertical exposures pass through a generally uniform distribution of assays of all grades, in complete contrast to the crosscuts.

With this fact established, the shape and mass of the orebodies between levels were outlined, and the corresponding areas plotted on plans of the 140-ft. and 250-ft. levels; and divided into blocks. The next step was to plot the mean areas between levels, and also the positions of the correspondingly proportioned heights of the bores affecting the subsequent calculations.

The boreholes were then grouped to make primary triangles, and using the principle that between any two sampling positions the value of either one is held to extend halfway to the other, the triangular areas were divided by lines bisecting the sides and normal to them. The bisectors were then produced to form secondary polygons for calculation, making use of a second postulate that the value of any point within a block, in this case the polygonal prism, is for the purpose of computation held to be that determined at the nearest sampling position, in this case the borehole. Thus each borehole was weighted, or its value was felt, by an accurate area of which it was the centre.

The horizontal area of each polygon was measured separately by planimeter, and the volume was obtained from the area and vertical height of the ore exposed in the bore. The volume divided by the density factor, determined from specific gravity tests and checked by weighbridge tests, gave the tonnage of each polygonal prism. This tonnage was weighted by the average value of the ore exposed in the bore, adjusted by the assay-plan factors, and the average value of each ore reserve block was calculated from the sum of the relative contents. It follows that an increase in tonnage may be expected, beyond that included in the calculations, of lode material below minimum grade, which from the mining of adjacent ore will be relieved of some part of the mining cost and thereby become payable.

All occurrences of high assays were checked, and where individuals were arbitrarily reduced, the reduction was made by substituting for the high figure the average ascertained including it, and then recalculating the average with the figure so reduced.

*Conclusions, Reliability of Sampling*—The assay-plan factors used in the calculations are the consequence of all the statistical testimony available at present, and a more accurate corrective factor for the rate between sampling results and head value will not be obtained until determined by mill operations. The opinion is held that eventually it will be demonstrated by mill operations that any practical form of domestic sampling will have to be abandoned as unreliable for the valuation of reserves, at any rate in the oxidized zone of this large, low-grade but erratic deposit. In other words, the assay-plan factor found to be necessary will probably be so large as to show sampling for this purpose to be useless, which would mean that no ordinary statement of reserves is possible.

Concerning the reliability of the

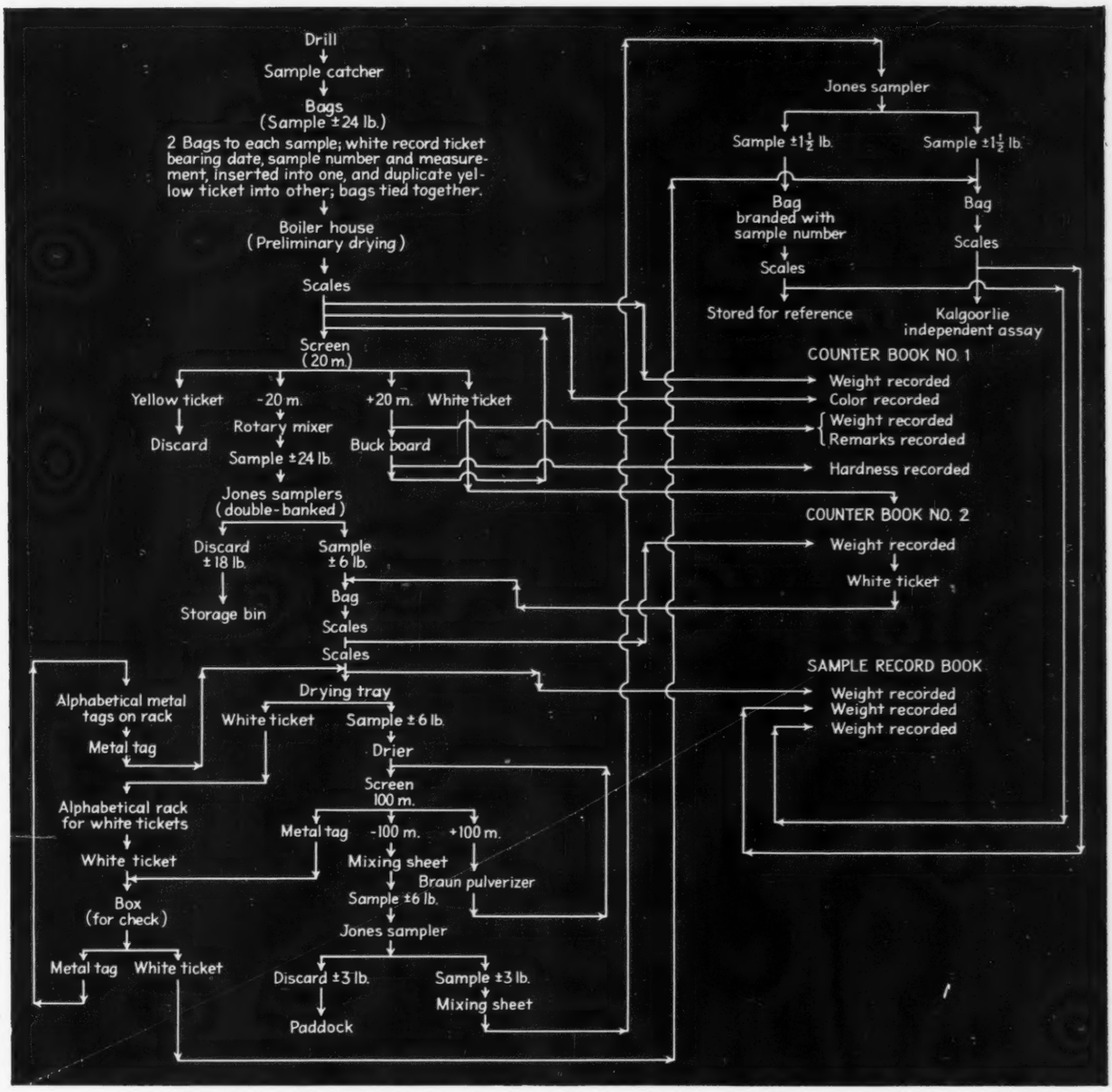
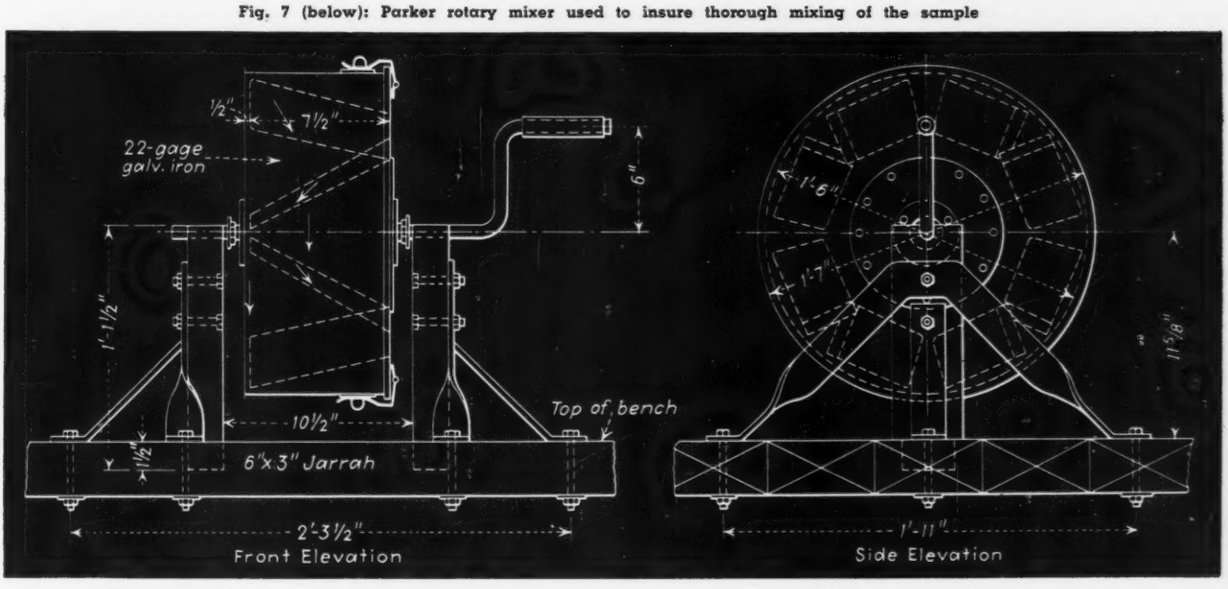



**Fig. 6 (above): Preparation of samples for assay proceeded according to this flowsheet**

**Fig. 7 (below): Parker rotary mixer used to insure thorough mixing of the sample**



# Ventilation Improved By Bratticing in Shaft

## *Outstanding results obtained at East Geduld Mines on the Witwatersrand*

CONFRONTED with the question of ventilating during the development period the area served by No. 2 shaft, and later to supplement existing ventilation, the management of East Geduld Mines, Ltd., operating in the Transvaal, solved the problem successfully in a novel manner. The method evolved was to box in completely one of the six compartments of No. 2 shaft with timber to act as an upcast, the fresh air being downcast in the other compartments. The shaft guides were removed to give the least resistance to the upcast air. Another advantage offered by this method was the fact that isolation of the compartment would completely exclude from it all water making and falling in most vertical shafts, which, as shown, has an appreciable effect in reducing the quantity of air upcast.

No. 2 shaft of East Geduld is a six-compartment structure, the dimensions of which are 40 ft. 3 in. by 9 ft. 6 in. outside the timbers. The compartment to be bratticed was the end compartment opposite to the pipe and cable compartment. It measures 6 ft. 8 in. by 8 ft. inside the timbers, the other chambers being 5 ft. 8 in. by 8 ft. each. To insure longevity of the bratticed structure, it was necessary to employ timber that was practically immune to dry rot, free from knots, soft and easy to work, and not subject to warping. After experimenting with various types of timber it was decided to use California redwood. To avoid distortion of the timber, holes were drilled for the nails.

The timber was cut in lengths of 13 ft. 5¾ in. by 7⅞ in., placed vertically to extend over two sets, and bevelled to leave a gap of ⅛ in. on the inside of the compartment to allow for expansion due to moisture. The corners of the compartment were made airtight by a 3x3-in. fillet. In the shaft, all timber was handled in a specially constructed four-deck skeleton, with a ladder and manhole between each deck. The top deck was loaded with timber to be used during the shift, under the charge of one timberman with a native assistant. The skeleton proper was equipped with six skids, one on each side of the long axis of the shaft and two each on the short axis. These skids were essential, as the shaft guides were removed prior to commencing the bratticing. A clearance of 3 in. was allowed between the skids and the shaft timbering to accommodate the skeleton inside the completed bratticing.

The first operation of removing the shaft guides was accomplished in eight shifts, with two shaft timbermen employed on each shift. Bratticing was started from the main station at a vertical depth of 3,800 ft. from the collar, and was completed in about five weeks at a total cost of £5,594 12s. 0d. This included the bratticing from the main station down to the waste loading bin, a distance of 337 ft., or a total depth of 4,137 ft., and an overall cost of £1 7s. 1d. per foot (timber cost in the United States about 40 per cent less).

While bratticing progressed, it was found necessary to throttle the strong upcast in the compartment to permit the timbermen to work in comfort. After this work was completed the quantity of air upcasting was found to be 60,000 cu.ft. per minute without mechanical assistance. During the period when development work was confined to the vicinity of the shaft, ventilation of the development ends was effected by leading galvanized iron pipes from each end direct into the bratticed compartment of the shaft, so that for a limited time the fresh air was drawn into the headings and exhausted into the upcast without fans. Working conditions in the development ends, both during the shift and after blasting, were remarkably good.

As development progressed, a crosscut was driven connecting the bratticed compartment with the workings, and two 15,000-cu.ft. Sirocco fans installed, discharging into the crosscut.

(*Continued on page* 49)

**Details of Costs of Bratticing Ventilation Compartment of No. 2 Shaft, East Geduld Mines, Ltd.**

| | £ s d | £ s d | £ s d |
|---|---|---|---|
| Stores and Materials: | | | 5,062 12 10 |
| California Redwood: | | 4,828 10 1 | |
| 1,212 lengths 13′ 5¾″x3″x3″ | 164 0 2 | | |
| 20 lengths 15′ 6″x3″x3″ | 3 2 3 | | |
| 13,200 lengths 13′ 5¾″x7⅞″x1⅛″ | 4,391 9 7 | | |
| 220 lengths 15′ 6″x7⅞″x1⅛″ | 84 3 7 | | |
| Total | £ 4,642 15 7 | | |
| Add 4% commission | 185 14 6 | | |
| Bolts, nuts, washers, etc | | 3 12 3 | |
| Candles and carbide | | 11 0 | |
| Clothing — oilskins | | 29 16 6 | |
| Iron and steel | | 45 10 9 | |
| Timber — other than Redwood | | 55 9 6 | |
| Pulleys and blocks | | 13 11 1 | |
| Tools — sundry | | 14 3 4 | |
| Sundry stores, including nails and screws | | 71 8 4 | |
| European wages: | | | 380 11 5 |
| Native wages: | | | 104 12 9 |
| Native compound costs and feeding: | | | 35 9 0 |
| Accident insurance premiums: | | | 11 6 0 |
| Grand total: | | | £ 5,594 12 0 |

Total depth of shaft bratticed: 4,137 feet
Cost per foot £ 1 7s. 1d.

## A New Technique

(*Continued*)

boring system of sampling described, it has given the closest approach to a true indication of tonnage and value that is possible within practical limits for this particular deposit, on account of the mainly horizontal distribution of the gold. But the combination of the horizontal distribution, over small distances and of varying tenor due to fluid spread, with the occurrence of the comparatively small irregularly vertical tracts of high-grade ore in the massif of the ore-bodies, provides the basic solution to the sampling problem, and explains the unreliability of any form of sampling other than large-bulk mill tests. The chance of vertical exposures, though more or less equally and closely spaced as in the boring program, intersecting a representative number of the tracts alluded to, or the high-grade ore surrounding them, due to their sparsity and relatively small size, is very remote. Owing to lack of sufficient observable data, it has not been possible to include any direct effect of these occurrences in the computation, but the application of the provisional assay-plan factors may be regarded as covering this influence to some extent.

# *Exploration?*

## *Or is it merely mine evaluation?*

*The author finds the exploration department of the large mining company less venturesome than he would like to see it*

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SOME of the large mining companies operating in the United States still maintain "exploration departments" and keep field engineers on the payroll in spite of the fact that the country is oversupplied with gold, silver, copper, lead, and zinc. To me it seems that the question might be raised as to whether they are searching for additional sources of these metals to be drawn upon for future needs, or merely to maintain these staffs from force of habit and to avoid further "technological unemployment." Inasmuch as making work is an innovation of Government not as yet exactly popular with the leaders of industry, I am forced to conclude either that the engineers employed in so-called exploration work must be expected to find new mines, or that their bosses have not yet gotten around to the point of separating them from their jobs.

Assuming that there is still reason for searching for these metals, let us inquire into the causes for the apparent lack of success in developing new mines. Conversation with the heads of exploration departments soon develops the fact that from their standpoint it is a very discouraging business. Thousands of reports are read in their offices each year, thousands of miles are travelled by their field men, hundreds of samples are taken, dozens of properties are examined—but very little ground is broken, because it is so very difficult to find anything on which to start mining. Of course the thousands of reports read in the various offices are not all different, for these reports are repeaters—they make the rounds of the exploration departments from New York to San Francisco, via Denver and Salt Lake, returning by way of Los Angeles, El Paso, Pittsburgh, and Philadelphia, until they are worn out by attrition or mislaid. Sometimes they are read more than once in the same office by different engineers, because of congestion of files or inaccurate cross-indexing. Field men follow each other from property to property and it is by no means unusual to find three or four sets of sample channels in the mine workings. The last of these visitors saw exactly the same ground as the first, unless perhaps the owners had managed to break a few more rounds in the interim. This procedure of report reading and field examination covers much of the work of the exploration staffs as conducted during the past two or three decades in the United States. It is based upon the hypothesis that mines are being developed by the prospector, "leaser," or small operator. This may have been a good theory thirty or forty years ago, when outcrops were still being found that would pay to work "from the grass roots" and when there were old mines in Mexico and South America containing large tonnages of milling ore left by earlier operators. At any rate it has dominated the minds of the engineers directing explorations in the Western field for many years.

Just what is it that the man in charge of the exploration department hopes to find?

This is a hard question to answer logically, and I admit that I do not know the answer. It is not a prospect rich enough to work profitably from the start, for these are invariably grabbed by the local storekeeper, small capitalist, or operator who has enough money to get out a shipment of ore to the smelter or near-by mill. It is not possible in such a case to get the property on terms acceptable to the company management. Next comes the property on which there is a promising surface showing, but on which little or no work has been done because of lack of pay-grade ore on outcrop. The field engineer will rarely take a chance on recommending work on an area of this sort because he feels that, if it does not turn out well, it will be a black mark on his record. The first time I encountered this attitude was on a property where the surface indications were those of a large disseminated copper deposit; the examining engineer reported adversely because chalcocite enrichment had not been proved—he refused to recommend exploration.

We next come to the small mine with some ore in sight and perhaps a profitable operation under way. Such a mine was brought to the attention of the vice-president in charge of exploration in the field for a silver mining company having ample resources. This mine had about 20,000 tons of ore blocked out averaging $16 a ton in gold (at $20.67 an ounce), a small mill, a shaft 400 ft. deep, and a large unexplored area; there was a sufficient profit in sight based on the costs actually being made in the mine and mill, to pay for the property and yield a small surplus for further development; by making some inexpensive additions and changes in the mill the margin of profit could be materially increased. This mine was favorably located as a center for district exploration and operation, a few miles south of Mojave, in southern California. The old mines on Soledad Mountain, inactive or at the point of shutting down at the time (1912), are only a short distance away and would have offered a promising field for investigation; they have since been reopened as a result of the work of prospectors and "leasers" which resulted in important new finds. Other old districts were easily reached by automobile, and none had been explored by modern methods at that time.

This chief engineer ordered the mine examined, did not visit it himself, and refused to take it over following a favorable report by his field engineer. He, the chief, said the mine was too small, that what he was looking for was a property with several million dollars worth of ore blocked, which would carry the company's dividend requirements over a period of years. His sights were raised too high. He was conducting a mine evaluation department under the name of "exploration," and he never found the object of his search—a big developed mine.

Ten years later the exploration department of a great smelting company examined a copper property in California; the mine had been opened to a depth of 2,500 ft., showed two oreshoots of a grade which had permitted successful mining over a period of

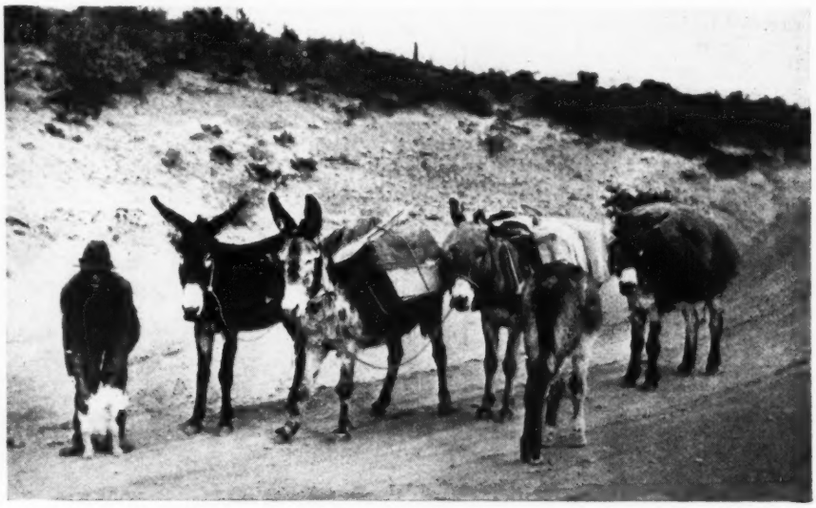
fifteen years or more on a production basis of 100 tons daily. The ore is complex, averaging about 4 per cent copper, 9 per cent zinc, with $2 a ton in silver and gold (silver 50c., gold $20.67 an ounce); mill tests indicated that a copper concentrate could be made sufficiently free of zinc to avoid penalty, that a zinc concentrate of commercial grade would be obtained, and that satisfactory extraction of all metals was possible. The examining engineer estimated a profit of $250,000 for the company's share, said nothing about the exploration possibilities of the region, which had never been investigated. The company management turned down the proposal on the ground that the enterprise was too small for them to undertake; there was only about 100,000 tons of ore blocked out. The representative of another smelting company said he was not interested in the data nor in exploration. All he wanted to know, he said, was whether there was ore enough for a 500-ton mill.

Neither of these gentlemen was conducting an exploration department. As before, "mine evaluation" would be the more descriptive term. Their attitude seems to be due to the idea that engineering is based on exact methods of measurement, that by sampling and measuring, and by estimating tonnage and average value, recovery and cost, mining is reduced to an exact science and the risk eliminated. But the risk is not done away with. It is only avoided by those engineers or mining companies who refuse to take it and who wish others to assume it for them. Engineers now determine the policy of nearly all the large companies, and their ideas have not changed very much on the subject of exploration in the past fifty years, except as they have been forced to change them by necessity. In the Mississippi Valley districts they explore by drilling because that is required; in Ontario they strip glacial debris and muck, or sound it with steel points to locate quartz, or diamond-drill favorable formations, because there is no other way to go about the business. But in the semi-desert Western States, California, Oregon, and Idaho, the field engineers still want to sample and measure ore found by someone else—the man who does the exploration work, prospector or owner.

Theoretically, then, there ought to be a field for the partial development of mines, with the idea that when this has been done the large operating companies, with adequate capital at their disposal, will take over and pay the explorer for his work. However this does not work out so well either, because examining engineers seem unwilling to take reasonable mining chances, and refuse to recommend further exploration work; and their employers are unwilling to allow an adequate share to the man who has assumed the initial heavy risks of exploration and development, risks which the company exploration departments would not take. Their attitude seems to be that the prospector or operator who has proved enough ore to justify a mill, but who cannot finance mill construction, is a poor manager and ought to be pleased to have the property put into production on any terms offered.

As an instance of such difficulties there is the history of a property developed under my direction from the prospect stage to a mine with about 700,000 tons of ore in sight averaging $2.60 a ton in gold, on which the profit exclusive of cost of mine and mill equipment, should be $1 a ton or better. Of this tonnage 85 per cent can be mined cheaply by open cut. Contractors' offers for breaking the ore and handling it to the mill range from 25 to 35c. a ton; careful tests by metallurgical consultants show that the ore can be treated by cyanide leaching with coarse crushing (4 mesh), low consumption of cyanide, obtaining 90 per cent extraction of the gold, to which may be added 10c. a ton for silver not counted in the average value given above. The estimated cost of milling is 50c. a ton or less, on a basis of 500 tons a day. Equipment could be provided at an outlay within $250,000. There is no unfavorable factor except the low grade of the ore, and several operations in Nevada and California have been based on averages as low or lower, without such favorable conditions for mining and milling. Given an equal tonnage of mill tailings of like grade, requiring classification and regrinding, it would be comparatively easy to raise money for a plant; but there seems to be something about the thought of breaking and handling rock, even when part of it can be shoveled without blasting and the rest can be broken with very little powder, which causes examining engineers to question a mining cost below 50c. a ton. Even if that figure were used, there would be a good margin of profit.

Next is the engineer's objection as to the small tonnage—not enough, he says, to yield a satisfactory mining profit, though admitting $400,000 net to be divided between the men who took the initial development risk and the company which would build the mill on a half-and-half basis. This would only mean the return of the investment and a profit of 80 per cent over a four-year period. "Not so good," says the chief of the exploration department.



**An old-time prospector poses with his companions for the camera. There was never any question about his burning desire to find a mine. Photo by courtesy of A. L. Flagg, Phoenix, Ariz.**

But so far nothing has been said about exploration. The tonnage cited has been developed to an average depth of 125 ft. over an area averaging 100 ft. wide for a length of 800 ft. Only a small amount of work has been done to determine what happens at depth, and surely gold distributed fairly uniformly through a block of ground of that size makes an ore deposit worth exploring to its limits, both along the strike and at depth. However, the conservative engineers of the exploration departments say that the original group ought to continue the work; "show up 5,000,000 or 10,000,000 tons of that grade of ore and we might be interested—possibly, not probably, because of course so many things might happen between now and then." Costs may rise to unprecedented heights, the Government may lower the price of gold, or the Government may corner all the gold in the world and the metal

may then be demonetized by international action, excluding the United States. All these objections or considerations have been urged regarding this little gold mine, which, if it had been promptly provided with mine and mill equipment as soon as it had ore enough to pay out, would by this time have repaid all cost of development and equipment, with a profit of 40 per cent or more.

However, we are talking about exploration. The district is an old one which has had several important mines discovered and worked out—perhaps—in early days. The type of ore deposit mentioned—extensive replacements of limestone by quartz and gold-bearing pyrite, which is usually low in grade on this property but occasionally shows much higher value—is a new one as far as district exploration is concerned, and conditions are such as to favor the possibility of discovering other orebodies of higher grade. In the early period of prospecting, quartz veins were worked to some extent in many localities, but unless high-grade ore was found on surface the work was soon abandoned. Such veins have never been adequately developed, simply because prospectors could not make a living out of them unless they found ore that would stand shipment to the smelters. Here there is no difficulty in finding and tracing the veins and by surface examination and sampling in determining where to look for oreshoots. It is with the beginning of underground exploration that difficulties are encountered, for the terrain is rugged in the higher parts of the area and roads and trails are few. However, there are no serious obstacles in the way of taking in diamond drill rigs or compressors mounted on skids, and supplies can be packed in without much difficulty for the initial operations. No drilling has ever been done in the district. The first work was performed with modern equipment.

If money were available for exploration on the scale and by methods seen in the Canadian districts, I believe it would be possible to bring about a notable revival of mining in many such areas in the Western States. To do this, however, we must develop a new viewpoint as to exploration work. A practical program would be somewhat as follows:

Select a district in which conditions are favorable to the occurrence of the type of deposit sought, either because of past record of production or because of general considerations based on mining geology. This is not a matter of difficulty because we now have a fairly thorough knowledge of Western mineral provinces.

Obtain as much information as possible from a careful study of surface and underground workings where available; investigate ownership of the more promising properties, acquiring development options and locating claims where ground is open. There are many old districts where patented ground is held by estates or absentee owners, or has reverted to the State for unpaid taxes; in many such districts there is land open for location, due to the lapse of possessory rights. It is almost always possible to make more favorable terms by going direct to owners than by dealing with promoters who bring options into city offices, for these middlemen usually expect commissions out of all proportion to their services.

## District Studies May Give Worth-while Results

As a result of such a district study it is likely that one or more properties which are worth proving by drilling or underground work will draw attention. Among these chances it may be necessary to make a choice depending upon relative cost, or on certainty of outcome, as to which to try first. This is, or should be, a matter of practical judgment; it is dangerous to become too much influenced by theoretical considerations. For example, a complex fault problem may appeal to the geologist and result in a recommendation to spend several thousand dollars in verifying its solution, although because of the complexity of the problem the chance of error is great and from a practical standpoint the bet is a bad one. I know of one such case where a few hundred dollars spent in work above a fault subsequently proved that the orebody pinched out before it reached the fault zone, but this obviously desirable work was only done after a large sum had been spent looking for a continuation on a lower level. Sometimes question arises as to the advisability of reopening old workings, the idea being that costs were high during initial operations and that stope fillings and oreshoot extensions ought to yield an important tonnage of milling ore. Unfortunately, the old-timers usually had high-grade to work with and could afford to throw in quite a lot of marginal ore with it, so that what they left in fill, pillars, and extensions is not necessarily above their cost limit.

There are, however, certain conditions which favor exploration in old districts. Unless there were high-grade outcrops to start on, the possibility of finding large bodies of low-grade ore in some areas still exists; most of the low-grade ore now being mined in Western districts was first opened in the course of working better material. Careful sampling on an extensive scale of deposits formerly considered unworkable has had favorable results in several cases. Another line of investigation worth considering is that of crosscutting in areas where there is good evidence of parallel veins, or vein systems, where the veins are found in shattered zones, or where there is indication of lenticular oreshoots in wide mineralized formations. Miners, both old-timers and those of today, long for regularity in their veins and when they have good walls to follow there is a tendency to neglect crosscutting. Then there are the outcrops which show signs of extensive mineralization, but little or no pay ore; this may be due to leaching of original sulphides, to the fact that the outcrop is in an unfavorable formation, or to the vein horizon exposed. In the case of copper deposits the theory of leaching and secondary enrichment is well understood; with gold and other metals much less importance is attached to this line of reasoning, so that it is difficult to get funds for the exploration of veins which do not show ore on outcrop.

At this point the conservative representative of the exploration department will object that it is impossible to go about the country working on barren veins, or on projects suggested by geological theory. For his part he much prefers to travel about in an automobile, conducting a little desultory sampling of ore showings here and there, quite secure in the knowledge that the chances are 1,000 to 1, or better, that he will never find anything sufficiently encouraging from his point of view, to require the actual undertaking of mine development.

I contend, however, that this is not exploration, but merely touring the country under conditions of minor discomfort. Suppose that the oil companies had adopted the policy of never drilling a well until some independent wildcatter proved an area, or a deeper productive horizon, what would have happened to their production? More to the point, consider where the gold output of Ontario would stand today had exploration been conducted by the visit-and-sample method which has been so popular in our Western States. The only way to find ore deposits in the future, as in the past, is to break ground and take development risks; we can lessen the risk somewhat by the application of knowledge gained in the study of ore occurrence, and we can pilot the work a little more surely by the use of geophysical methods, and by properly interpreted drilling. But in the end it is necessary to get down to work, drive tunnels, sink shafts, and trust that in the long run enough ore will be found to pay for it. As the available supply of metals decreases, necessity will force the adoption of the proper methods of exploration, and the office engineer will give way to the field engineer or the practical miner who is able to deliver the goods.

# Newfoundland Ships Fluorspar

## Production from St. Lawrence region, begun in 1932, has increased steadily

**C. K. Howse**
*Associate Government Geologist*

**R. P. Fischer**
*Temporary Assistant Geologist (1936)*
*St. Johns, Newfoundland*

FLUORSPAR CLAIMS were first located in the St. Lawrence region in 1910, but the district did not come into production until 1932, when the St. Lawrence Corporation of Newfoundland, Ltd., started work on the mining claims of W. E. Seibert, of New York City. Production has increased steadily since that time. In 1937 the American Newfoundland Fluorspar Company, Ltd., which is allied with E. J. Lavino & Company, of Philadelphia, began exploration on its holdings. (Fig. 1). A third group of claims in the area, on which promising finds of spar have been made, is up to the present time lying dormant.

In 1937, Newfoundland attained the position of third largest exporter of fluorspar to the United States, contributing 15 per cent of that country's imports. The recently concluded Anglo-American Reciprocal Trade Agreement, which reduces the United States duty from $5.60 to $4.20 per ton on Newfoundland spar containing more than 97% $CaF_2$, will no doubt further enhance the position of Newfoundland spar in the American market.

*Geology*—The general geology of the area is similar in many respects to that of the rest of southeastern Newfoundland. Much of the region is underlain by Pre-Cambrian rocks consisting of volcanic flows and breccias, slates, sandstones, and conglomerates. Locally these are overlain unconformably by sandstones, shales, and limestones of Cambrian age. These formations were intruded by the St. Lawrence granite stock or cupola, within which all the workable fluorspar veins occur, and by rhyolite and diabase dikes. The rhyolite dikes are offshoots of the granite, and at least a few of the diabase dikes are later than, and cut, the rhyolite.

*Structure* — The structure of the region is complex, the rocks having been intensely folded and faulted. At least two major periods of deformation have occurred; one during the late Pre-Cambrian, and the other sometime after the deposition of the Cambrian beds but before the intrusion of the igneous rocks. The Cambrian beds strike in a general northeast-southwest direction and generally dip to the southeast at high angles; in places they have been closely folded and overturned. West of the area included in Fig. 1, the Pre-Cambrian rocks have been thrust onto the Cambrian, the thrust plane paralleling the general strike of the Cambrian beds. The Pre-Cambrian rocks are still more intensely deformed, and only the competent volcanics exhibit the northeast-southwest structural trend.

The fissures in the granite, of which the fluorspar veins are the fillings, all strike within about 50 deg. of a line normal to the long axis of the St. Lawrence granite stock. Furthermore, the mean between the extreme strikes of 59 deg. and 155 deg. (See Fig. 2) is 107 deg., which is about normal to the long axis of the stock. Apparently, these fissures are tension cracks in the granite due to regional movement and contraction on cooling.[1] The dip of the veins ranges from vertical to about 65 deg., with a few minor exceptions. At the Black Duck and Iron Springs veins, where opportunity is afforded to study the hanging wall and the footwall underground, there is evidence of some vertical movement along these fissures.

The granite for the most part is miarolitic and locally exhibits chill phases along the borders of the body, although these chill zones are rarely conspicuous. In all probability this granite stock is rather shallow-seated. A few miles northwest of the St. Lawrence stock is a similar granite body, called the Lawn stock. These two bodies are not known to be connected at the surface, but it is our opinion that these bodies are probably connected at no great depth below the present surface. The Lawn stock is apparently a rather flat-topped body, and there is some evidence that the St. Lawrence body is also a rather flat-topped stock where it lies nearest to the Lawn granite. Nevertheless, the walls of the St. Lawrence granite where exposed along the coast at Chamber Cove and Ferryland Head are either vertical or steeply outward dipping. No fluorspar has as yet been found in the Lawn granite.

*The Fluorite Veins*—These veins are fissure fillings and are typically epithermal, commonly consisting of finely banded fluorite along the walls and coarsely crystalline fluorite in the open centers of the veins and in vugs, all more or less brecciated and containing a varying amount of granite breccia. The banded fluorite suggests rhythmic deposition, and most of it is evidently earlier than the coarsely crystalline material, although in several places it has been noted that this banded ore fills small fissures and cracks in the crystalline ore. Vugs and openings in the veins are commonly lined with fluorite crystals. Practically all of these crystals are cubic in form. A few octahedral crystals have been found on the ore piles, but in every case these octahedral forms have an outer coating of small cubes jutting from the octahedral faces. In addition, a combination of cubic and dodecahedral forms has been noted. By far the greater part of the fluorite is primary in origin.

The gangue in the different veins varies both as to composition and amount, but consists principally of

**Fluorspar Shipments of the St. Lawrence Region**

GROSS TONS

| | Acid Grade +98% $CaF_2$ −1% $SiO_2$ | Cyanamid Grade 93–95% $CaF_2$ 2–4% $SiO_2$ | Steel Grade +85% $CaF_2$ −5% $SiO_2$ |
|---|---|---|---|
| 1933 | ..... | 390 | 1,169 |
| 1934 | 270 | 1,066 | 746 |
| 1935 | ..... | 2,202 | 1,132 |
| 1936 | 1,627 | 1,792 | 4,940 |
| 1937 | 1,939 | 937 | 5,690 |
| 1938(*a*) | 3,169 | 1,104 | 2,892 |
| 1938(*b*) | 1,800 | ..... | 600 |

(*a*) Shipped up to November. (*b*) To be shipped.

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[1] Balk, Robert: "Structural Behavior of Igneous Rocks." Geol. Soc. of Amer., Mem. 5, p. 123, 1937.

brecciated granite, fine-grained quartz, and calcite. Associated minerals, which usually make up less than 1% of the veins, are galena, chalcopyrite, pyrite, chalcocite, azurite, chrysocolla, hematite, opaline and crystalline silica, barite, limonite, pyrolusite, bitumen, and clay.

Granite constitutes the principal gangue material and varies from fresh the rounded inner portion. This was followed by the rhythmic deposition of fluorite with small amounts of galena. In the higher grade veins, however, there is little evidence of replacement and the granite fragments are mostly angular.

The fluorite may be colorless, white, yellow, red, pink, blue, or purple; a wide variety of colors is to be found impurity is iron oxide, which is usually present in amounts of less than 1 per cent.

Small amounts of optical spar have been found in the Iron Springs vein. The relatively heavy blasting charges used, however, cause so much shattering that it is unlikely that any appreciable amount of this is recovered.

The origin of the fluorite in the

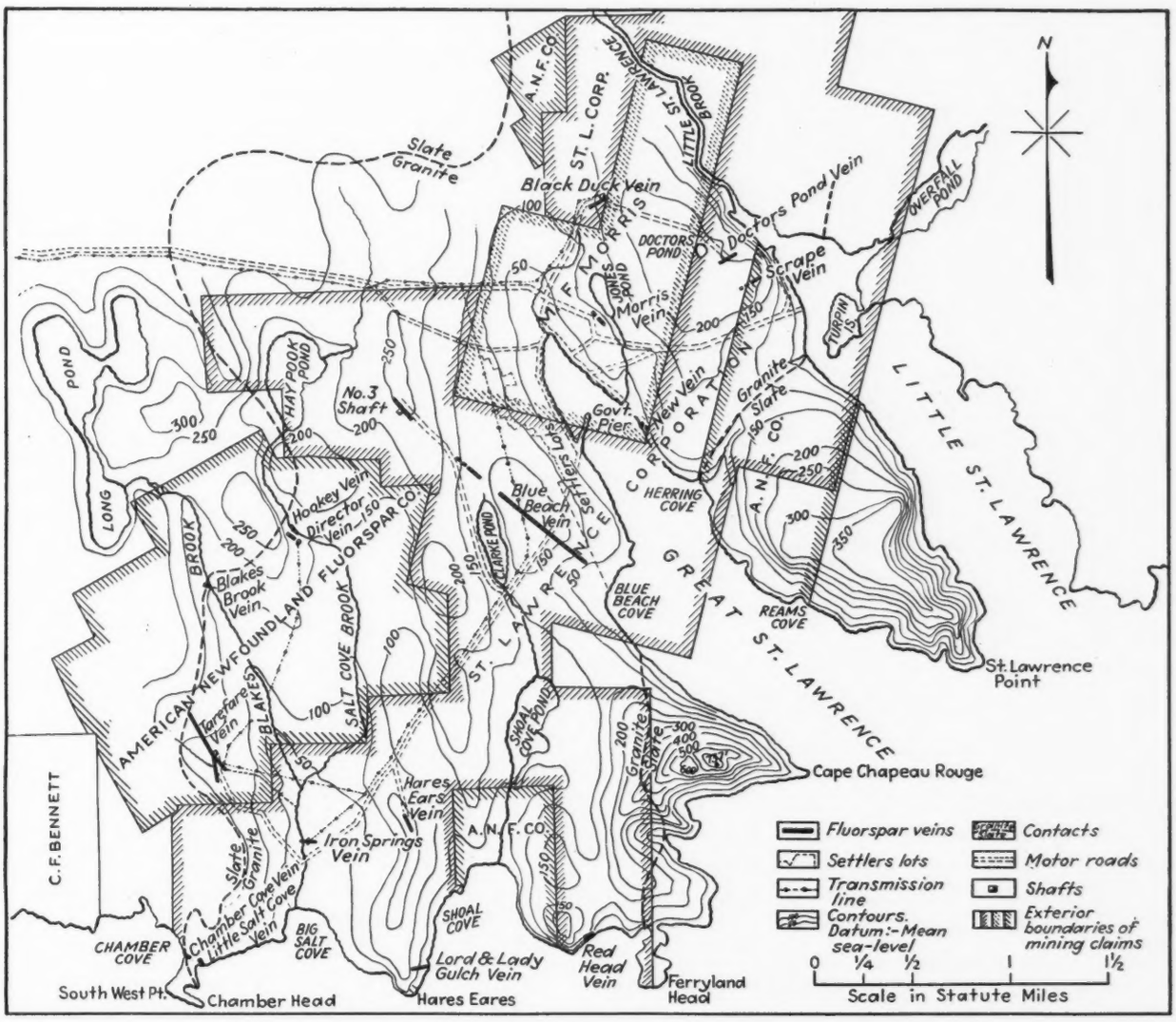



**Fig. 1. The St. Lawrence mining area is in the southeastern part of Newfoundland. It is approximately 5 miles from north to south and about the same from east to west**

angular unreplaced fragments to rounded and replaced material bearing little or no resemblance to the original. At No. 3 shaft on the Blue Beach vein, a part of the fluorite occurs as nodules of impure fluorite surrounded either by bands of fluorite with a rather high silica content, or in some cases by galena. The most reasonable explanation of this phenomenon is that, following the original fissuring and brecciation, the fluorite-bearing solutions dissolved the outer parts of the granite fragments and replaced in practically all veins. The various shades of blue and purple may possibly be explained by the presence of traces of manganese oxides, the yellows and reds are definitely due to varying amounts of iron exides, and the greens, it is thought, likely result from the presence of chrysocolla or malachite.

The dull, massive, red variety of ore is perhaps the highest grade mined, and is also the most unprepossessing type of spar in appearance. This type is almost silica-free and the only other veins of the St. Lawrence area presents a problem that has not yet been solved. As the granite is apparently a shallow-seated body, the fluorite veins being typically epithermal fissure-fillings, and as there is an absence of pegmatites and high-temperature vein deposits in the granite, the question arises as to whether or not the fluorite deposits are genetically related to this granite. It is possible that consolidation took place for a considerable distance within the cupola before the separation of the

**At the Black Duck fluorspar mine of the St. Lawrence Corporation, St. Lawrence, to date the largest producer in the district. Here the first work in the area was done**

hydrothermal phase and that these veins represent the low-temperature deposits of this phase. On the other hand, the fluorite veins may be related genetically to the diabase intrusions.

*Development* — Activities began in 1932 with the mining of spar for export, with no preparatory exploration or development. The outcrops of the known veins were stripped and mining was carried on by trenching. Until last year no systematic scheme of exploration and development was undertaken, with the result that little underground information is available.

The first work was done on the Black Duck vein, and it has continued to be the largest producer to date, though the more recently developed Iron Springs vein may exceed it in yield before long.

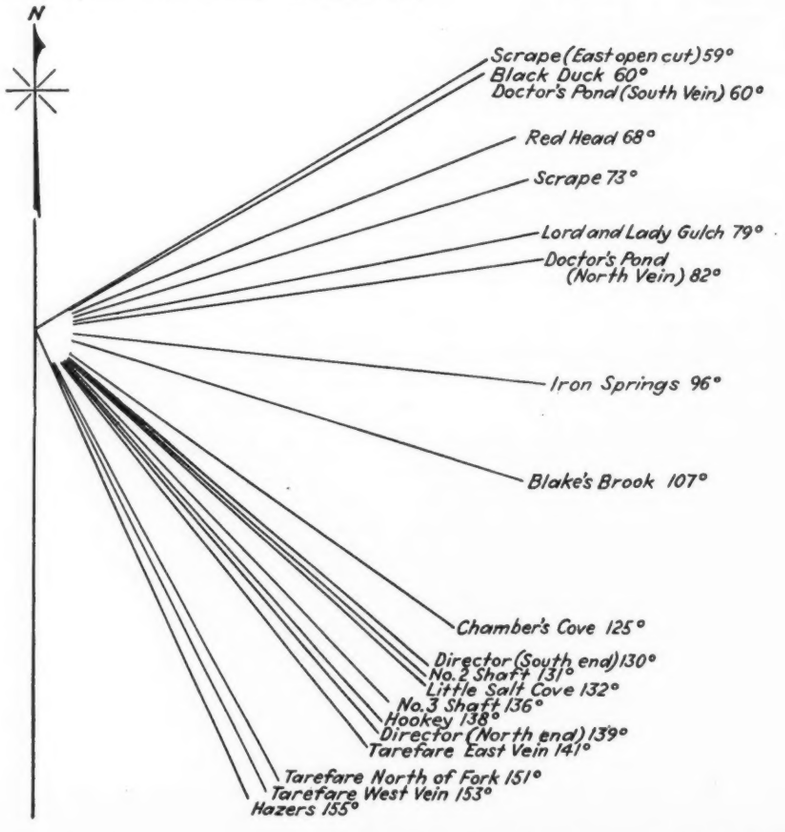
At the Black Duck mine, the vein was stripped on the surface for 350 ft. and work was continued by underhand benching in the open cut. At a depth of 90 ft. this open cut was abandoned because of the inflow of surface water. A shaft was then sunk below the floor of the open cut near the east end, leaving a pillar of 25 ft. and a level was run west from the shaft for a distance of 350 ft., and to the east for 115 ft., where pinching and faulting were encountered. Underhand benching was continued from this level to a depth of 180 ft., where the shaft was deepened and a new level started. The vein varied in width at the surface from 6 in. to about 8 ft., with an average width of about 4 ft. About the same dimensions were present at the 180-ft. level, and there appeared to be no decrease in the tenor of the ore. Banding in the ore at this level was just as pronounced and of the same type as that found above, but vugs were not as common as near the surface.

To date 16,160 tons of ore have been removed from the Black Duck vein. It is planned to explore this vein further to the west by means of drifting.

The Blue Beach vein shows the greatest length yet demonstrated; it has been traced by means of trenches for 7,700 ft. It appears that this vein contains three, or possibly more, shoots of spar. Some extraction has been done on all three, though the spar shipped from No. 1 shoot at the southeast end of the vein is negligible and only a few hundred tons have been mined and shipped from No. 2, the middle lens or shoot. The most work on this vein has been done at No. 3 shaft. In 1935 this shaft was sunk to a depth of 70 ft. and it was planned to drift and stope from this level. This vein is interesting because at a depth of 60 ft. it was found that the original hanging wall, which consisted of a very fine mixture of fluorite and silica, had come in under the spar as if the vein had pinched out. After sinking about 5 ft. through this, however, a massive white spar with clean walls was encountered. It is possible that this depth represents the water table, and that the movement of groundwater to this level dissolved the spar and caused a cave-in of the hanging wall. In 1936, open-cut operations were begun in the vicinity of the shaft and spar was mined to a depth of about 40 ft. and for a distance of about 170 ft. along the vein.

The two largest producers of steel-grade spar exclusively are the Blue Beach and the Hares Ears veins. The Hares Ears vein was worked by an open cut to a depth of about 40 ft. during 1936 and the early part of 1937. This vein varies in width from 11 to 14 ft. and has a vertical dip.

**Fig. 2. The strike of the fluorspar veins varies as shown. Here they are plotted from a common point. In every case, however, it is within about 50 deg. of a line normal to the long axis of the St. Lawrence granite stock**



It appears to pinch abruptly at the southeastern end, as if faulted, but faulting has not been definitely proved. The spar in this vein is mostly white and massive, with veinlets of creamy colored fluorspar and silica running through it in all directions. Calcite is present in the lower parts of the workings.

### The Tarefare Vein

Exploration on the Tarefare vein was begun by the American Newfoundland Fluorspar Company in the summer of 1937. Surface trenching indicated a total length of about 1,500 ft. of fairly high-grade spar. The main vein branches near the southeast end into two smaller veins. A 90-ft. shaft was sunk near the intersection of the veins. At a depth of 50 ft. a crosscut was run to intersect the west vein, which appeared to have widened somewhat, although the hanging wall carried some calcite. At the 80-ft. level, crosscuts were run to the two veins and extended a short distance beyond the west vein, where another small vein was discovered. The three veins at this level carry some calcite, but if sufficient tonnage is available the spar can be satisfactorily milled. Mining operations here have been suspended temporarily.

The Director vein has been traced by means of trenching about 600 ft. and a prospecting shaft is being sunk. The surface indications of this vein show possible widths of up to 35 ft., and the vein where explored underground has a maximum width of 12 ft. This vein dips at an angle of 45 deg. southwest and is perhaps the most gently dipping vein in the area. The grade of this vein varies from the footwall to the hanging wall; it appears to be probable that the richer part of the vein will make acid-grade ore.

The Lord and Lady Gulch vein shows some fairly high-grade spar outcropping on the face of the sea cliff, and has been traced inland for a few hundred feet. Contracting work began in 1937 on the cliff face and about 100 tons of good ore was removed. The spar in this vein resembles somewhat the Black Duck and Iron Springs ore but contains a large amount of granite breccia. The vein varies in width from 3 to 7 ft.

The Iron Springs vein was discovered in 1935 and was located by means of a mineral spring the waters of which contained an appreciable amount of iron hydroxide. Stripping was begun that year and high-grade fluorspar, similar to that at the Black Duck mine, was uncovered. To date this vein has been worked in an open cut, 350 ft. long, to a depth of about 50 ft. The vein varies from 2 to 9 ft. in width, pinching and swelling rather rapidly, and dips from 65 deg. to 70 deg. to the south. The walls of this vein are clean, and grooves and scratches on both the hanging wall and the footwall give evidence of some vertical displacement. This vein has produced the highest grade ore yet mined in the district; there is little or no granite breccia in the spar and acid grade ore is obtained by very little hand picking. In December, 1937, a drift was driven for some 50 ft. beneath the brook at the west end of the open cut. This work showed one of the widest and highest grade parts of the vein; previously the vein had not been picked up on the west side of the brook, due to overburden. Further surface exploration since June 1938 has proved a length of 1,250 ft. for this vein.

The veins mentioned in the foregoing are the best developed and at present the most promising in the area. Three others — namely, the Scrape, the Red Head, and the Church veins—are noteworthy for their considerable width and apparently have large tonnages available, but in each case there appears to be a large amount of included granite breccia, and it is doubtful if these deposits can be economically worked by the present hand-picking methods. Their value will best be determined when mechanical concentration of some type is employed.

*Milling Practice*—Milling practice as at present developed consists wholly of hand picking and crushing to size. The ore is brought to a picking grizzly, where acid lump and granite gangue are removed. The fines through the grizzly go to a dewatering and settling tank, and the coarse goes through the trommel. Trommel screenings go to the same dewaterer as do those of the picking grizzly. The oversize from the trommel goes to a picking table, where granite and any calcite which may be present are picked. Acid spar from the picking table present goes to a conveyor belt to the acid bin. Gravel spar goes to a 1-in. jaw crusher and thence by a bucket conveyor to the bin.

### Tests With Flotation

Experiments have been and are now being made with oil flotation and air separation. With flotation a high-grade product can be obtained, but it appears that the ore would have to be briqueted. We have been informed by the technical director of one of the companies at present in the field that air-separation experiments have given excellent preliminary results, and with this method there is a possibility that crushing to one-half- or three-eighths-inch sizes may be sufficient. If either of these methods proves satisfactory there is available in the area a much larger tonnage of fluorspar than can be extracted economically by the present hand-picking methods.

*Power*—Hydro-electric power is supplied by the United Towns Electric Company, Ltd., from its plant at Lawn, about 8 miles west of St. Lawrence. That company operates two 160-hp. diesel generators as auxiliaries, but experience has shown that its combined sources were not capable of supplying sufficient power during the dry season. At present, therefore, the United Towns Electric Company, Ltd., is making preparations for the erection of dams and a power house on the Waterfall Brook watershed in Little St. Lawrence. With this development, ample power is assured for the area.

*Possibilities*—The future possibilities of the area have been somewhat jeopardized by the present system of surface mining. The majority of the veins are permeable and water works through the fissures and cracks in the fluorspar with no great difficulty. Cementing the bottoms of the present underhand open stopes has been suggested as a possible cure, but unless pumping operations on the open cuts are carried on simultaneously with underground developments, a dangerous head of water may collect. Filling of the cuts would appear to be more feasible, as arching of the fill would relieve the strain on level pillars. It has already been found necessary to erect concrete dams to protect some of the workings.

### The Shatter Cliff Brook Vein

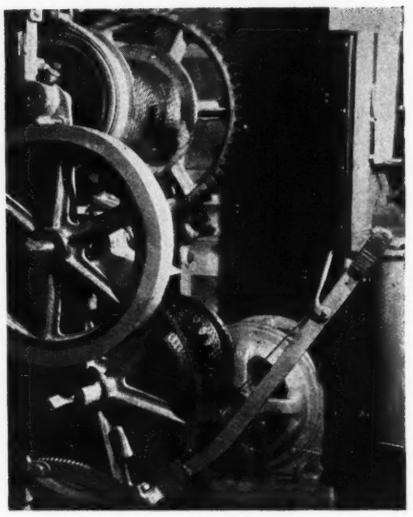
In December, 1937, a fluorspar vein was located on Shatter Cliff Brook, about three miles northeast of the Black Duck vein. The vein is very poorly exposed, and a grab sample showed 80 per cent $CaF_2$, 18 per cent $SiO_2$, and 2 per cent other impurities. This discovery is of importance as it extends the potential fluorspar area three miles farther to the northeast. The heavy overburden in the area has been a deterring factor in prospecting and exploration, but it is evident that this discovery has increased the possibility of finding further fluorspar reserves to the northeast.

We wish to express our appreciation of the co-operation given by the St. Lawrence Corporation, Ltd.. the American Newfoundland Fluorspar Company, Ltd., and their various officers and employees. Rudolph Kauffman, II, who acted as the senior author's assistant in the field season of 1935 and wrote a senior thesis (unpublished) at Princeton University on the work done and information obtained up to that time, and E. Herbert Waentig, assistant to the junior author in the season 1936, also deserve acknowledgment for their able assistance.

# Reclaiming a Shaft With a Stiff-leg Derrick

*Ground around the collar had been caved for years*
*Work was completed at a low cost*

**R. S. Blitz**
*Superintendent*
*Gilt Edge Mines, Inc.*
*Deadwood, S. D.*



**Double-drum crab showing brake drums with hand lever, back-gear guard, motor and control**

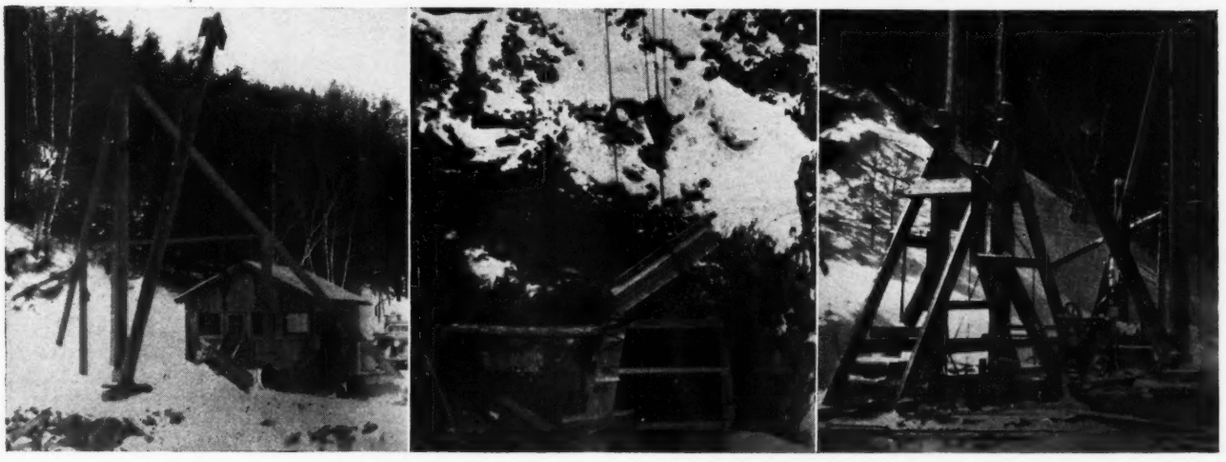
UNIQUE USE of a stiff-leg derrick was recently made by Gilt Edge Mines, Inc., of Deadwood, South Dakota, in reclaiming a shaft. The problem was to unwater a 300-ft. shaft, the collar and head frame of which, together with several sets of timber had caved many years ago, leaving a gaping hole about 20 ft. deep by 30 ft. in diameter. No maps with surface reference points to permit locating the exact position of the shaft were available, so it was necessary to excavate the caved material to a depth where solid timber could be found and to build up from that point to the surface. Water flowed from an old tunnel driven into the shaft at a point about 35 ft. below the surface where the shafthouse had been located, but this tunnel was also caved.

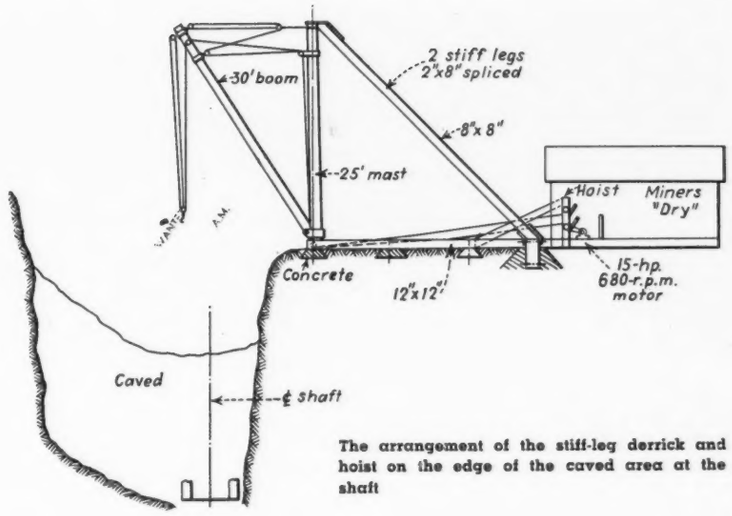
The work was carried out as follows: On a solid bank west of the shaft (the only solid rock wall) two 12 x 12-in. timbers 20 ft. long were bedded on concrete with sufficient room between them to accommodate the sheaves for the hoisting rope and the boom topping line. The cast-iron base casting was bolted to these timbers and between this and the cast-iron mast-step a large ball thrust-bearing was installed to facilitate the swinging of the boom. The swing was accomplished by a single-drum geared hand windlass with a $\frac{5}{8}$-in. rope wound on it, over on one end and under on the other for a like number of turns, after passing twice around a 48-in. bull wheel attached to the mast step. The mast was a 25-ft. cedar telephone pole with a 12-in. top, and the boom was a similar pole 30 ft. long. To these were attached the regular fittings and pulleys.

The hand crab or double-drum winch customarily used on such a derrick was revamped to accommodate a 15-hp. 680-r.p.m. hoist motor and the drums geared to give a rope speed of 100 f.p.m. At this increased speed it was necessary to bronze-bush the jack shaft and the back gear shaft. The drive from the motor to the jack shaft was a $\frac{3}{4}$-in. roller chain with 1-in. pitch and a working stress of 20 h.p. A half-inch 6x19 hoisting cable was used for both hoisting and topping lines. This had a breaking test of 10 tons and a working load of 2 tons, which was ample for handling the 8-cu.ft. buckets while mucking out the debris and later in handling the timbers, electric sinking pumps, and similar equipment. Brakes for each drum were made from Chevrolet flywheels bolted to the drums and grooved to hold the 2-in. brake lining in place. These gave sufficient braking surface to hold any load the hoist was capable of lifting and were operated by hand levers.

Solid timber was found 35 ft. below the hoist sills, and it was a simple matter to handle the 16-ft. 12 x 12-in. green wall plates as well as the long blocking timbers by changing the position of the boom, picking the timber of the ground at the surface, swinging it into exact position and then lower-

**Left, Stiff-leg derrick with combination hoist and change house in background. Hole caused by cave shown in foreground. Center, Raising shaft timber after cave had been mucked out and solid timber found in place. Lagging for lacing shaft sets is being lowered by derrick. Right, After the re-timbering had been completed the small headframe shown was erected. The trap doors are worked by a lever**






**The arrangement of the stiff-leg derrick and hoist on the edge of the caved area at the shaft**

ing it into place. After the timbering was completed, a small headframe was erected and a crosshead was attached to the hoist line, only a single sheave near the end of the boom being used for the hoisting cable. This gave a rope speed of 100 f.p.m. —sufficient to handle men, pipe, and pumps while the rest of the shaft was being unwatered. In the photograph an electric cable reel is seen in the background. The handling cable is on the winch over the shaft. The electric cable was served to the ⅜-in. steel cable with marlin every 5 ft., allowing the former to be lowered as needed with no weight on it. The electric cable was a 3/0 three-conductor cable with 600-v. insulation to handle two 40-hp. 440-v. centrifugal sinking pumps.

The cost of this derrick installed was less than $1,000, a figure that was undoubtedly low, due to our conditions. To duplicate it under ordinary circumstances, however, should not cost over $1500. Never having seen a similar layout, I think this description may help some engineer with a like problem.

▼ ▼ ▼

# Central Crushing and Sintering for T. C. & I. Ore Mines

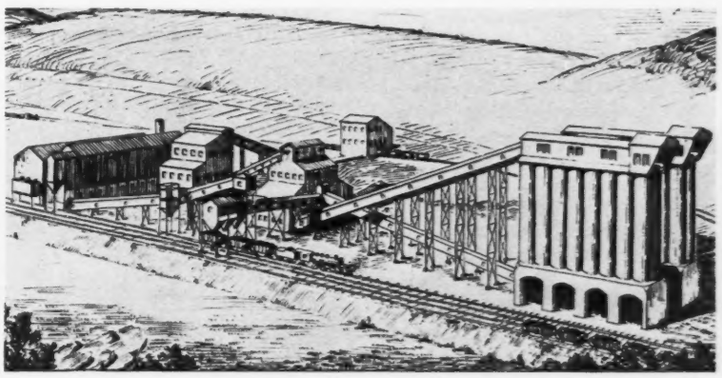
PLANS for building a central iron ore conditioning and sintering plant at Wenonah, Ala., in the Birmingham district, were announced on June 13 by Robert Gregg, president of the Tennessee Coal, Iron and Railroad Company, a subsidiary of the United States Steel Corporation. Construction will be started within the next few weeks. The new plant will be situated near Wenonah ore mine No. 7. According to Mr. Gregg, the company for several years has been giving considerable study to improved methods of preparing its iron ore for efficient smelting in its blast furnaces. Extensive research has resulted in this decision to install equipment of sufficient capacity to handle the current ore requirements.

Crushing ore at the individual mines will be discontinued. Ore will be loaded directly into railroad cars at the mines and transferred to the central ore conditioning plant, where it will be dumped into primary crushers. After preliminary crushing, it will be conveyed by belt conveyor to a second crushing station for final reduction.

Leaving the secondary crusher, the ore will go to a screening and continuous sampling station where it will be separated into three sizes, coarse, medium and fine. The coarse and medium sizes sizes will be sent to storage in steel silos. While the ore is thus held in storage, chemical analyses will be made. For removal to blast furnaces, the ore will be fed from silos by proportional feeders according to definite standards of chemical analysis.

The fine ore will be conveyed from the screening station to storage bins at the sintering plant. Flue dust from the company's blast furnaces and coke breeze also will be stored in adjacent bins. A portion of the fine ore will be mixed with the flue dust and coke breeze and sintered—that is, brought to a temperature sufficient for fusing.

Some alterations of ore stocking facilities at the Tennessee company's Fairchild blast furnaces will be required to coordinate the ore conditioning program. It is estimated that the plant will be ready for operation by late summer or autumn of 1940.



**Sketch based on plans drawn for central ore conditioning and sintering plant to be built by Tennessee Coal, Iron and Railroad Company, at Wenonah in Birmingham area. From left to right, the five major buildings are: sintering plant, secondary crusher building, screening and sampling plant, car dump and primary crusher building, and storage silos. In the front center are the loading bins**

▼

# Research on Tin

IN SURVEYING the work done by it in 1938, the International Tin Research and Development Council reports that, among other things, fundamental work upon effects of small amounts of other metals upon tin and tin alloys has progressed and a trace of tellurium has been found beneficial to the work-hardening properties and to provide a high ratio of creep strength to tensile strength. That grain-size has an important effect on tensile strength of pure tin and tin-rich alloys has been brought to light. Researches on bearing metals have been carried out on stresses produced by the differential contraction of the bearing metal and the shell into which it is cast; the adhesion to the shell; cracking at working temperatures; and the improvement of strength by addition of cadmium and other metals.

# Open-Pit Transport On the Mesabi Range

# VI

*Belt conveyors are economical where special conditions govern*

**L. C. Moore**
*Chief Mechanical Engineer*
*Cleveland-Cliffs Iron Company,*
*Ishpeming, Mich.*

DEVELOPMENTS in the last few years have proven that belt conveyors provide the most efficient and economical means for conveying and elevating many kinds of bulk materials, when quantities and distances fall within certain economic limits. In the coal industry this type of transport is used at one place for conveying 5,000 tons of coal per hour a distance of several miles. On large dirt-moving jobs these quantities are even exceeded. It is reasonable to conclude therefore that belt conveyors can be used effectively met in mining iron ore.

The advantages of conveyors are as follows:

1. The first cost is low.
2. Their capacity is large with low consumption of power.
3. They function on slopes of 20 deg. under practically all conditions met in mining iron ore.
4. They deliver a uniform volume at high speed.
5. Few parts are subject to wear.
6. They are simple, quiet, dependable.
7. Skilled operators not necessary.

Instances where conveyors may not be used to advantage are as follows:

1. The ore deposit in the pit may be made up of high-grade pockets with horses of rock in between requiring other kinds of haulage, to an extent that is too great, to get the ore to the conveyors economically.
2. When the ore is of a "soupy" consistency, it is difficult to elevate it on a conveyor belt. This occurs in pits that do not drain easily.
3. The pit may be too wet to install a conveyor along bottom of the orebody.
4. The quantity of ore in the pit may not warrant the installation.

The foregoing brings us back to a statement previously made, to the effect that every pit has its peculiarities and that these must be analyzed to determine the best method of transport for the conditions. To consider these four instances of disadvantage with respect to the conditions of the "average pit" on which data were given in a previous article[1], we find that No. 1 does not apply, inasmuch as the ore deposit in the "average pit" is fairly uniform and the conveyors can be run through the center of it so that the "gathering distance" will not exceed 600 ft. Under such a favorable condition three types of gathering equipment may be used: A, Sauerman scrapers, B, trucks, C, tractors.

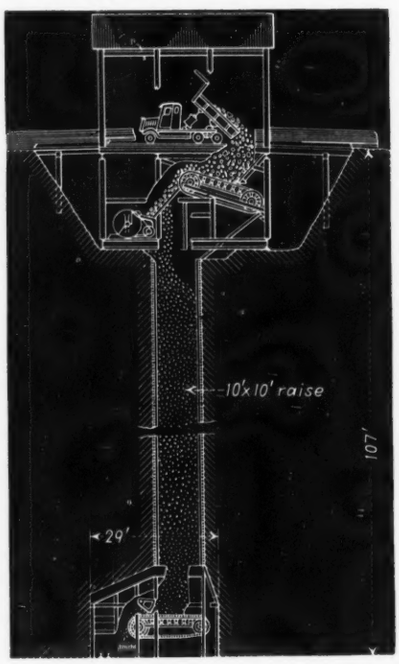
With a bed of ore 120 ft. thick as shown on the accompanying cross section taken through the orebody, to use a Sauerman scraper or trucks, for bringing the ore to the conveyor, it is necessary to locate the belt conveyor in a drift driven along the bottom of the orebody, then to raise from the bottom of the pit to the surface and install a dump, a pan-conveyor feeder, a grizzly and a pocket, as shown in the sketch attached. If the scraper is used, an excavating tower that can pull 600 ft. with a traveling anchor tower to return the bucket would be needed. The equipment in the raise will be the same whether the "gathering" be done with scraper or truck. The length of conveyor haul from the bottom of the raise to the top of the pit bank is approximately 1,200 ft. and from this point to the washing plant 13,700 ft.

A question of prime importance that must be settled on attacking the problem is, how far can a belt conveyor be run economically. In the case before us, let us first consider running it from the pit bottom to the washing plant, a distance of 14,900 ft.

From an examination of costs on several large jobs where belt conveyor installations were completed as one contract by a manufacturer, it appears that a good "rule of thumb" for estimating can be set up between two limits. For high-class installations, the width of belt in inches multiplied by its length in feet multiplied by $1.50 gives a figure that is within 10 per cent of the installed cost. For cheaper installations the $1.50 can be reduced to $1.00. By a high-class installation is meant a layout having all supporting structures built of steel with safety sequences on all motor equipments; with such sequences in use, when one belt section stops, all belts back of it also stop, eliminating any chance for ore to pile up at transfer points. Applying the rule formulated, a belt conveyor installation 14,900 ft. long and 30 in. wide would cost 14 900x30x$1.50, or $670,000, which exceeds the cost of any system so far discussed, and is too high to be considered for a 7,000,000 ton deposit.

We must therefore try another combination in which the belt conveyor will take the ore to the top of the bank, from which point two electric lorry trains with three 30-cu. yd. cars will carry it to the washing plant. With this installation the cost of ore transport will be given in Table XVI.

**Fig. 5—The ore broken in this case is delivered by truck or scraper to the pocket, from which it goes to the crusher and thence down the raise to the conveyor. Drawing after one in *U. S. Steel News***




Part V appeared in the March issue and Part IV in the January issue, 1939.

[1] See "conditions" on page 52, Part II, November, 1938.

**Fig. 6—The pit shown is served by a belt conveyor installed in a drift driven along the bottom of the orebody. The drift is connected by raise with the floor of the pit**

The electric lorry car trains were selected for surface haulage as they could be used to better advantage during winter stripping and cost less to maintain and operate than do other types of haulage previously considered. The crew that is required to operate and maintain the scraper installation and the belt conveyor is made up of 1 hoistman, 1 helper, 2 pocket men and 1 belt feeder, a total of 5 men. As this equipment can be used only on ore the estimate must be based on 240 shifts.[2]

*Conclusions.* Comparing these figures with those in Table XIV giving a summary for electric lorry operation with three trains in the pit, it shows that the lorry car train used in the pit not only has the advantage in first cost and operating expense but has flexibility in being able to take care of winter stripping with no additional equipment, this in comparison with all the means of transport discussed in this article and the five that preceded it. If tractors or trucks are used to move the ore in the pit to the belt conveyor pocket, the additional expense will be approximately the same and a further study of pit conditions would be necessary to determine which is the best.

Were it possible to revamp the haulage system by moving the washing plant to the edge of pit, pile the discarded rock in worked-out sections of the pit and pump the tailings to the same basin, the picture of transport by belt conveyor would undergo a radical change and this system would be an ideal means of moving the ore from pit to washing plant, a distance not exceeding 1,500 ft. on a 20 per cent slope. With the best installation the cost would not exceed $67,500. After treatment the ore would drop into railroad cars for shipment. This arrangement would not provide for winter stripping, however, so the belt conveyor would fit in only where stripping is completed and nothing but crude ore needs consideration. The range has pits fullfilling these conditions, such as the St. Paul mine, a view of which was shown in the October issue.

Another question given serious consideration by operators is the economy of driving drifts to accommodate conveyor equipment compared with running the conveyor up the bank of the ore pit, exposed to the weather. In one case the cost of the drift was $50 per ft. in addition to the cost of the belt conveyor which was $45 per ft. If the banks are steep and rocky, the cost of the additional belt conveyor necessary to reach the railroad loading bin can easily offset that of the drift required to reach the same point.

Our discussion of the subject of open-pit transport in these articles leads to the conclusion that belt conveyors will be found the most economical means of transport for open pits where special conditions govern in the pit.

*Open-pit transport by means of trucks will be considered in the next and concluding installment.*

**Table XVII. Operating Expense, Using Scraper and Conveyor**

| | | |
|---|---|---|
| Electric power for pit shovel and washing plant | $47,227 | |
| Electric power for haulage | 9,300 | |
| Total | | $56,527 |
| Train maintenance | | 2,200 |
| Labor | | |
| Crew—wages, motormen | | 3,800 |
| Crew—wages, brakemen | | 2,400 |
| Crew—Sauerman scraper and belt conveyor | | 6,880 |
| Lubricants | | 50 |
| Maintenance of tower scraper, belt conveyor and tracks | | 5,400 |
| Total | | $77,257 |
| Fixed charges at 13% | | 50,765 |
| Total | | $128,022 |

[2] See "conditions," p. 52, Part II, November, 1938. Item 10 states that the total number of 8-hr. shifts in ore is 240. Inasmuch as this equipment is, so to speak, built into the orebody, it can not be used for stripping.

**Table XVI. Cost of Ore Transport. Conveyors and Lorry Trains**

| | |
|---|---|
| 1200 ft. belt conveyor, cost (1200 x 30 x $1.50) | $54,000 |
| Scraper tower and equipment, as per sketch | 100,000 |
| Pocket on bank | 30,000 |
| 2 three-car lorry trains at $55,000 each | 110,000 |
| 2½ mile distribution system, at $5000 per mile | 12,500 |
| Driving 250 ft. drift at $50 per foot | 12,500 |
| Completing raise 120 ft. long at $100 per ft. | 12,000 |
| Track system, 2½ miles long, at $12,000 per mile | 30,000 |
| 1 substation—500 kw. capacity | 30,000 |
| Total | $391,000 |

## Ventilation Improved

(*Continued from page* 38)

Each fan served a separate district, the intakes to the fans consisting of 36-in. diameter galvanized iron piping split as required and reduced to 30 in. or 22½ in. to serve the various development ends. Where necessary, air-driven fans were installed at set intervals to insure circulation of fresh air at the headings. Through these installations the quantity of air upcast was increased from 60,000 cu.ft. per minute natural ventilation to 78,000 cu.ft., the bratticing being carried some distance up to the headgear to avoid short-circuiting. At a later period a 120,000-cu.ft. fan was installed on the surface to augment the air upcast in the bratticed shaft compartment.

The bratticing described has now been in use for about two years and has proved satisfactory in every way. It was found necessary to protect the bratticing by lagging with Oregon planks over a depth of 1,200 ft. from the collar of the shaft, as it adjoins the rock compartment and was slightly damaged by falling rocks due to spillage when tipping. The cost of the lagging is not included in the cost per foot cited previously. Examination of the shaft timbering around the bratticed compartment has presented no difficulty, as it is possible to get access to at least 80 per cent of the sets in the compartment. It is anticipated that the bratticing will last as long as is necessary, and provisions are being made to examine the inside of the compartment periodically. In addition, dust-laden air from ore bins and heated air from the main pumping stations are being led direct into the bratticed compartment, thus eliminating the expense of dust-recovery plants and their necessary excavations.

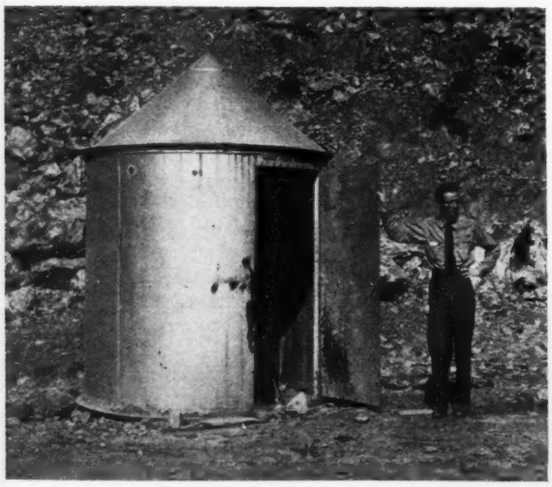
The outstanding results obtained by bratticing the ventilation compartment of No. 2 shaft, East Geduld, led to its immediate application to shaft-sinking operations at No. 4 shaft, Grootvlei, which was then under supervision and control of East Geduld. It was anticipated that if the bratticing of the ventilation compartment could be kept within a reasonable distance of the shaft bottom, it would lead to a considerable improvement in the working conditions.

The results actually obtained exceeded expectations, as the volume and velocity of the air downcasting in the five compartments, assisted by the fan normally used for sinking, were such that the shaft bottom was kept clear during the lashing, blowing over, and drilling operations. The smoke fumes after blasting were immediately exhausted into the bratticed compartment. It was then no longer necessary for the following shift to travel through smoke and fumes.

Part of the open pit at Morenci with the benches. Some of ore is exposed at the right

# *As Phelps Dodge Prepares to Mine*

One of the 22½-cu. yd. trucks, used for hauling waste and ore



Steel shelter in the pit for protection while blasting

OPEN-PIT MINING by the Phelps Dodge Corporation on its Clay orebody at Morenci, Ariz., has progressed to a point where the contour lines of the pit are clearly defined and a part of the ore is uncovered. Preliminary study on this large project was started in 1930, with actual mining getting under way in August, 1937. The amount of recoverable copper ore in the Clay deposit is estimated at 230,000,000 tons carrying 1.06 per cent copper, the mining of which will entail the removal of about 239,000,000 tons of waste material. The minimum amount of stripping required to uncover the ore is about 40,000,000 tons. The present output is more than 25,000 tons of waste rock per day and 1,500 tons of ore which is being used for testing purposes. Transportation of these materials to respective points is accomplished entirely by trucks, the average length of haul being 0.6 miles and the maximum 1½ miles. Operations are on a three-shift basis.

The sides of the pit as worked by bench methods, each bench being carried at a height of 50 ft. and an average width of 100 ft. Waste is removed by 4½-cu. yd. electric shovels loading into 22½-cu.yd. trucks. The ground is broken by blast holes put down by electric churn drills using 9-in. drill bits. Initial drilling on hillsides and blockholing are done with jackhammers chucked for 1¼-in. and 1-in. round steel. Detachable bits exclusively are employed in this work.

For general road and construction work in the pit area 1-cu.yd. diesel-driven shovels, 5-cu.yd. trucks, and diesel-powered tractors equipped with hydraulic bulldozers and towing winches are used. The machinery on the 4½-cu.yd. shovels is actuated by electric cur-

A network of roads in the pit area at Morenci

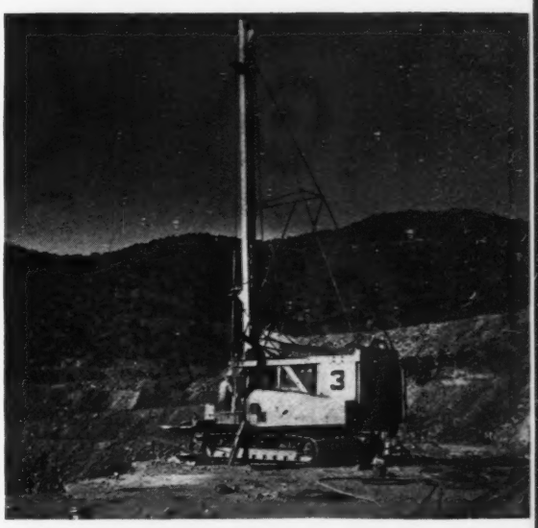
Bench operations with 4½-cu. yd. electric shovels and 22½-cu. yd. trucks at work

# *its Clay Orebody at Morenci, Arizona*

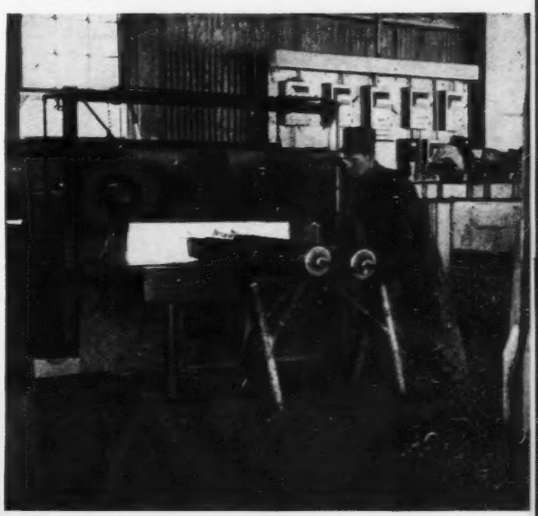
rent delivered at 2,300 v. Power consumption is 0.186 kw.-hr. per ton of material loaded. The normal output per shovel per 8-hour shift is 5,000 tons, and the total operating cost for the four units employed is $52.81 per shift.

The 22½-cu.yd. trucks have 10 wheels fitted with pneumatic tires and an all-steel body operated by an hydraulic dump mechanism, and they are powered with gasoline motors. They can operate on grades as high as 15 per cent, but in the pit road grades are maintained at 6 to 7 per cent, making possible a maximum truck speed of 15 m.p.h. The total cost per truck shift has been found to be about $31.

All roads are served by two sprinkler trucks. Upon completion of the section of railroad track between the Morenci terminal and the pit entrance, truck haulage will be confined to establishment of benches. On benches and dumps 90-lb. rails will be used for track construction, and 131-lb. rails will be laid on the main lines. Waste and ore will be loaded into 30-cu.yd. drop door cars and 100-ton gondola cars respectively. These will be hauled in trains to the designated dumps and to the crushing plant that is to serve the 25,000-ton concentrator yet to be constructed Diesel-electric locomotives will be used on the initial waste haul. The track to the crushing plant, about 1⅓ miles long, will be on a grade of 0.4 per cent, and the rail sections to the dumps will be on 0.2 per cent grades. From the assembly yard 2 miles distant from the pit, the upper ore benches will be reached via four switchbacks over a compensated grade of 4 per cent. The accompanying photographs were taken by John B. Huttl on March 25.




An electric churn drill at work in the pit



Heating churn drill bits at the central shop

Railroad fill on track section running from Morenci terminal to pit

# How a Grinding Circuit Was Improved

*A novel elevator installed on ball-mill discharge trunnion delivers to vibrating screen, the undersize going to unit flotation cell and the oversize with tailings to rake classifier*

**L. D. Gilbert**
*Mechanical Engineer*
*Grass Valley, Calif.*

UP TO LAST JULY the equipment in the fine-grinding department of the 300-ton flotation plant of Lava Cap Gold Mining Corporation, which operates mines near Nevada City, Calif., consisted of a No. 86 Marcy ball mill, having a scoop feeder and a 28x36-in. circular screen at the discharge end and in closed circuit with an 8x20-ft. Dorr classifier; a No. 500 Denver unit cell; and a 16-in. screw conveyor. In other words, the machinery and general layout were more or less those found in a modern flotation plant. As this was operated, it involved a somewhat wet mill and a coarse screen which let a large amount of pulp, too coarse to float, flow to the unit cell. In addition, any repairs required on the circular screen necessitated a shutdown of the mill circuit and consequent financial loss.

To overcome these difficulties, I. O. Proctor, mill superintendent, who had decided to change the screen and unit cell layout so as to insure maximum operating time and mill output (circulating load 4 to 1), called on me to collaborate in re-designing the installation. Investigation revealed the following requirements:

1. A vibrating screen covered with a screen to give a 10-mesh product, capable of handling 60 to 80 tons of pulp per hour, and so installed as to permit constant observation and accessibility. In view of the limited headroom, it would have to be of the horizontal type.

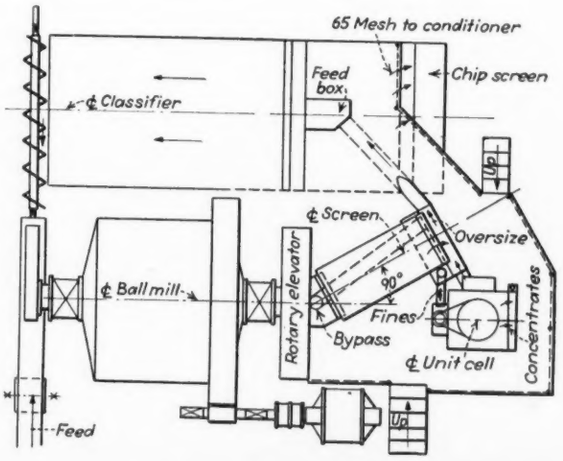
2. An adequate grade, say 2 in. per foot, to facilitate rapid removal of the sands and maintain proper pulp density. Because of insufficient headroom, this problem could be solved only by installing an elevator. Several standard designs were investigated but none could be used. Finally, the idea was conceived of fitting the discharge trunnion of the mill with a sand wheel and a proper bypass arrangement to eliminate any interference with the grinding circuit in the event of a shutdown of either screen or unit cell. A sand wheel of conventional design, in this case 6 or 7 ft. in diameter and running at 25 r.p.m., however, would not work, because the centrifugal force generated would remove the contents of the buckets before they reached the discharge point. From this criticism developed a second idea—namely, why not install the buckets of the elevator upside down and inside out as in the photograph and use both the centrifugal force and gravity? Subsequent tests showed that this could be accomplished with a properly designed bucket. Viscosity was another factor to be considered. The bucket should handle materials from 30 to 80 per cent solids at the rate of 1 to 2 tons per minute. Therefore, with 20 buckets set around the periphery of the wheel operating at 25 r.p.m., this would mean 500 buckets per minute, and as a consequence only a small amount of pulp would have to be picked up, held, lifted, and delivered in a split second by each bucket to transfer the material flowing from the discharge trunnion of the mill into the boot of the rotary elevator to the vibrating screen. A carefully worked-out stress diagram of a bucket line 7 ft. in diameter for each 10 deg. proved this assumption to be sound.

3. A method of freeing the mill circuit of tramp iron and other foreign matter. Occasionally, such material will get by the magnet in the crushing plant, and some is made in the mill.

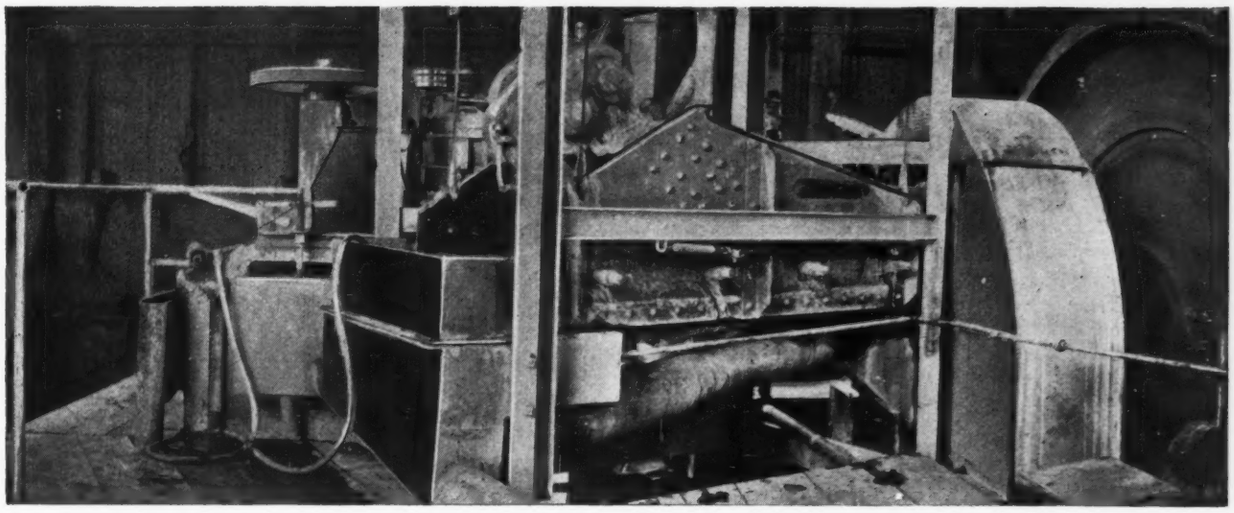
4. Density control. To insure maximum grinding efficiency in the mill, and subsequently prepare a proper feed for the unit cell by screening, the pulp at each stage to be under constant observation to permit operation both by sight and by sampling.

5. An arrangement for cutting the screen and unit cell, one or both, in and out of the circuit without shutting down the mill.

All the features described in the foregoing were incorporated in the final installation, as illustrated in Fig. 1. The equipment includes the No. 86 Marcy ball mill, mentioned previously, driven by a 250-hp. motor, and provided with a 46-in. scoop feeder and a 76-in. Gilbert-Proctor rotary elevator, respectively, on the feed and discharge trunnions. The ball mill discharges the pulp directly into the elevator boot (which in shape is a frustum of a pyramid). The front side of the boot is fitted with a clean-out door, to the cover plate of which is welded, at an angle of 60 deg., a 6x8-in. sounding pipe terminating with a milk-can type cover about 3 in. above the normal level of the pulp. Two ¾-in. hydraulic pipes and a 2-in. pipe are available at the bottom for clean-out purposes. The top of the elevator boot, carried on two concrete piers dowelled to the mill foundation and floor, is set 16 in. below the center line of the mill. Above the boot the elevator is covered with a steel casing in three parts, a right side and a left side, split at the back, and a cover. This housing also carries the head or receiving hopper, which at one end has a bypass launder made from 8-in. pipe, with a made-up elbow belled to 10 in. The flow of the pulp is controlled by a lever-operated poppet valve with a heavy rubber disk, the belled elbow serving as a seat. The pulp either can be sent to the vibrating screen or direct to the classifier by simply closing or opening the valve. With the elevator having an "internal discharge," the head (T-shaped, with the stem, 30 in. wide, out) is set on the center line, and the bottom 14 in. above the center line of the mill. The dis-




**Plan and elevation show how the arrangement of equipment in grinding circuit was improved**



**Rotary elevator, horizontal vibrating screen, and unit cell installation at the 300-ton flotation plant of Lava Cap Gold Mining Corporation, Nevada City, Calif.**

charge trunnion can be observed through a framed opening 30 in. square. The casing under the trunnion contains a screen with 2-in. openings as a safety measure in case a grate bar is broken.

In this installation the screen used is a 3x6-ft. Allis-Chalmers, single-deck, low-head vibrating unit driven by a 3-hp. motor. It was converted to a wet type by welding on a bottom plate to handle the screen undersize. The screen proper is held by four ⅜-in. cables carried by helical springs set in housings. The entire installation is supported by a steel frame with an operating deck made from 3-in. planks. Its discharge hopper is divided by a partition 6 in. high, the near side, with a 6-in. pipe take-off to the unit cell, receiving the undersize and the far side the oversize. An 8-in. pipe launder leading to the classifier feed box completes the circuit. The unit cell can be cut in or out by means of a valve devised in the elbow, which has been belled to 7 in., of the take-off leading to it.

The unit cell is a Denver Sub-A machine, with the feed intake on the back side. Connection departs from conventional practice in that a 10x16x24-in. feed box, having a welded-on 6-in. pipe connection for the screen discharge hopper take-off, was welded on to the cell tank in place of the ordinary 4-in. feed line. The top of this feed box is open and convenient for sampling and observation. A 2-in. sand relief also was added. The cell is driven by a 5-hp. motor.

In plan, the center line of the vibrating screen is at 30 deg. to the center line of the mill, and that of the unit cell is square and close to the discharge end of the screen. This makes a short connection both for the feed and the overflow which is attached to the oversize side of the screen discharge hopper. The 8-in. bypass launder under the screen also is connected. As a consequence, the oversize from the screen joins the tailings from the unit cell flowing to the classifier, thus making an ideal mixture for the classifier to handle. The launder handling this material discharges into a flat-bottomed feed box bolted to the classifier on the center line, with the bottom some 9 in. below the overflow lip.

*Operation*—A small amount of water is added to the feed to give the mill pulp, flowing from the discharge trunnion at a velocity sufficient to pass over the elevator buckets direct into the elevator boot, a density of 75 per cent solids. As the drop is about 30 in., the velocity at the end of the fall is some 13 ft. per second, which literally snaps out all tramp iron and other foreign matter with a specific gravity of 6 or better. Water is added through the two ¾-in. hydraulic pipes for the following reasons: (1) to reduce the density to 65 per cent, thereby making a good mixture for screening, and (2) to keep the pulp in the elevator boot agitated and to settle out any heavy foreign matter. This trap has proved satisfactory. Small pieces of blasting caps, wafer thin and less than ⅛ in. in diameter; fractions of electric blasting cap leads, No. 32 copper wise less than ¼ in. long; pieces of steel the size of No. 7½ shot; and particles of free gold are being found in the clean-up. The small amount of water used on the vibrating screen is applied through five ¾-in. spray nozzles, primarily for a final wash of the oversize, and to prepare a pulp of 55 per cent density for subsequent treatment in the unit cell.

The elevator delivers the pulp in a continuous stream and the screen settles down to a steady purr with ideal screening action shortly after starting the circuit. Stabilizers on the cables holding the screen eliminate all whip, and no vibration is imparted to the supporting structure. From 60 to 65 per cent of the gold and 45 to 50 per cent of the silver values are recovered by the unit cell. Cutting out this unit for a few hours has no adverse effects on the recovery; the circuit simply "riches up," and a greater amount of concentrates is skimmed off until it returns to normal.

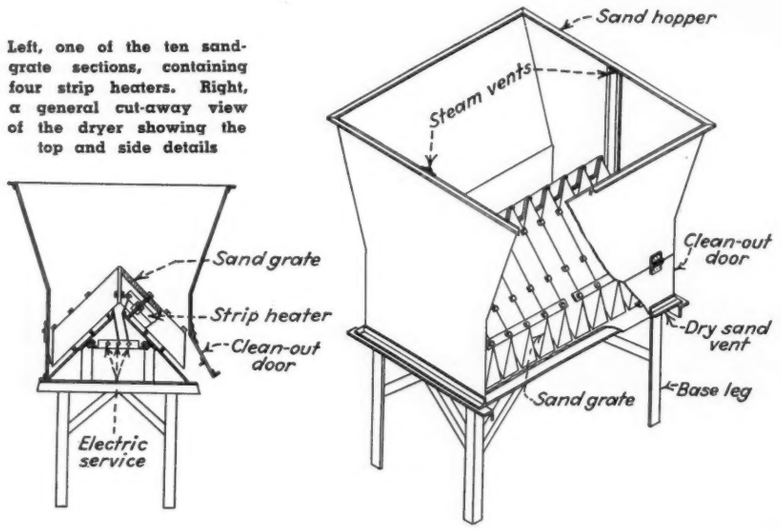
**The rotary elevator, close up, showing the buckets**

# USEFUL OPERATING IDEAS

## Drying Sand for Traction Purposes

WHERE sand used for traction purposes underground has to be dried, the electrically heated dryer, described by J. H. Whitesel, of the Potomac Edison Company (in a paper prepared for the General Electric Company's prize contest on the topic "Promoting Industrial Electric Heat"), may be found useful. The objective sought was a dryer of a capacity of 1,000 lb. of sand per hour that could be operated for about 50c. per hour.

Left, one of the ten sand-grate sections, containing four strip heaters. Right, a general cut-away view of the dryer showing the top and side details




Calculations showed that a ton of stored damp sand having 3 per cent moisture contained 60 lb. of moisture, to evaporate which would require approximately 20 kw.-hr. in two hours' time, or 10-kw. capacity at 100 per cent efficiency.

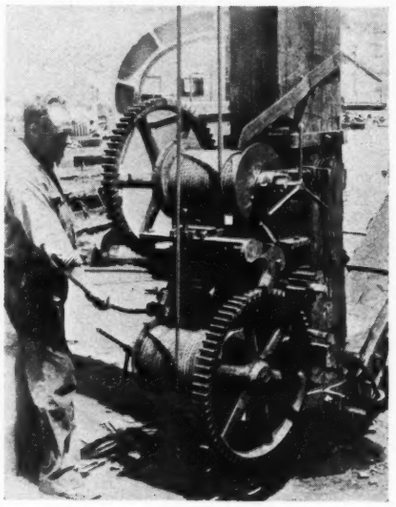
The hopper shown in the drawing will hold 2,500 lb. of damp sand. In the bottom are the so-called sand grates. In all there are ten sections, forming an inverted "V" assembly, which is the total heated surface. Each of the ten grates itself is also an inverted "V" not much unlike a normal angle iron inverted.

Electric heat is applied to this assembly by strip heaters, each of the ten grate sections containing four. These are mounted underneath and inside of the inverted "V" against the four flat surfaces and are held tightly in place by wedge-shaped supports. Each grate section is insulated at the bottom with sheet insulation to minimize the heat radiated downwards. The heated assembly is held on studs which are supported by a so-called sand pan, which is in turn supported by the main frame of the dryer. The dryer as a whole contains 40 seamless-tube, rust-resisting, 500-watt, 120-volt strip heaters, giving it 20 kw. electrical capacity. By series and parallel connections the wiring is made simple for 115-, 230-, 460-volt single-, 2- or 3-phase operation, 230-volt operation being preferred.

The strips heat almost entirely by conduction and are self-protected in that the wattage per square inch of radiating surface is not so high as to produce excessive temperatures when no sand is in the dryer, yet will be adequate for proper drying when the hopper is full.

The dryer has no moving parts. Between each of the grate sections at the bottom of the "V" there is a 3/16-in. slot. When the damp sand is thrown in, it does not escape through this, due to molecular attraction. As sections become heated, the sand in contact with the heated surface is dried and flows by gravity along the sides of the grates through steam vents in either end of the sand assembly.

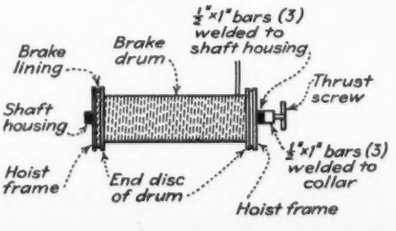
Capacity varies with the amount of moisture to be driven out. With an installation operating for over six months, where the damp sand is stored outdoors, the capacity has been about 2,500 lb. of dry sand in two hours.



## Emergency Brake for Guy Derrick

THE DRIVE PINION SHAFT of the hoist of the guy derrick shown in the photograph, together with the brake control sprocket mounted on its middle, slips endwise in changing from the boom sprocket to hoist sprocket, and vice versa. When geared to the hoist, as shown here, only the large "dog" (seen on the right side, where crank is applied to move the drum sprockets) keeps the boom from falling. The man is holding the brake lever, which now has no connection with the boom drum. If geared to the boom it would be disconnected from the hoist.

When the hoist frame broke a new one was cut out with acetylene torch, from 1-in. mild-steel plate, and all joints welded. Brake lining was applied between sprocket ends of the drums and the hoist frame, for emergency use. The drum is pressed against this lining by a thrust screw at the opposite end of the drum shaft. This screw operates in a 2-in. threaded collar, 3 in. long, held by three projecting bars of ½ by 1-in. steel, welded to the drum shaft end housing. Pres-

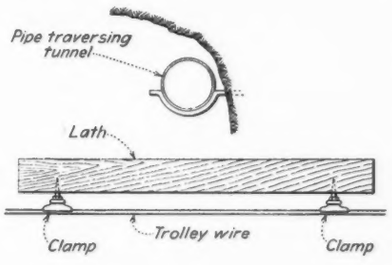


sure is applied with three 10-in. radial bars welded to the end of the thrust screw, which contacts the drum shaft inside the shaft end housing. The innovation was tested by dropping the boom and catching it successfully.

▼

## Trolley Wire Protector

IN HAULAGE TUNNELS and drifts traversed at intervals by pipe lines or other metallic underground auxiliaries, adequate protection of the trolley wire at such points is imperative if contact and consequent short circuits are to be avoided. Operations can be made safe either by covering the metallic object above the wire with rubber or wood insulation, or fitting the trolley wire proper with an effective guard. At the Magma mine of Magma Copper Company, Superior, Ariz., the difficulty




was successfully overcome by adopting the latter method, and the simple and inexpensive protector used throughout the underground workings is shown in the accompanying sketch. The device essentially consist of a short length of dry wood secured to the trolley wire by means of two conventional trolley-wire clamps. As will be seen, contact between the wire and the metallic object overhead is made impossible by the intervening wood lath, no matter how high the wire is whipped up by the trolley pole of the fast-moving locomotive.

▼

## Determining Nickel

FOR a rapid, quantitative determination of nickel, writes Howard B. Bradley, one should digest the sample in any mineral acid, free from most of insoluble. Add citric or tartaric acid, ammonium hydroxide until distinctly alkaline, and dimethylglyoxime (1 per cent alcoholic solution) until precipitation of nickel is complete. Filter through a fast paper and wash well with hot water. Redissolve precipitate with dilute hydrochloric acid, washing into original beaker. Add 20 cc. excess hydrochloric acid and two or three grams of potassium nitrite. Stir well for about 45 seconds. Add ammonium hydroxide until alkaline to litmus paper. Titrate with a solution of sodium or potassium cyanide standardized against a C.P. nickel salt.

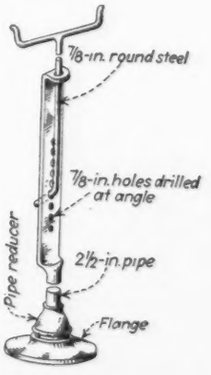
The ketone formed when the nitrous acid breaks the bond between nickel and the oxime, preventing reprecipitation of the nickel, does not take part in any subsequent reaction involving the nickel, cyanide, silver nitrate, or potassium iodide.

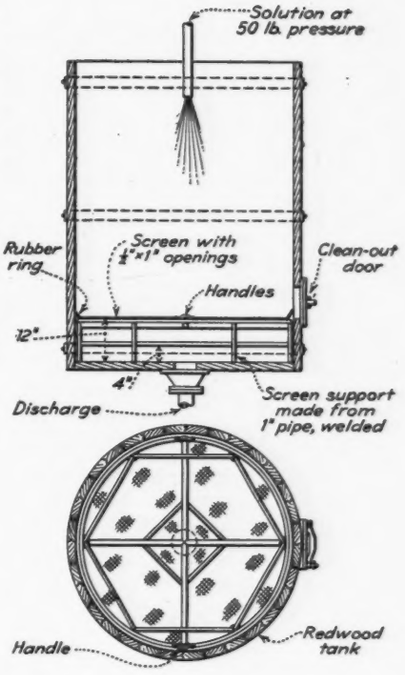
▼

## A Handy Stand for Shop Work

AN INDISPENSABLE PIECE of equipment, and one that is used for many different purposes at the mine, mill, and smelter machine shop, smithy, or assay office, is a stand or rest for holding up work. In construction, these units range from the simple carpenter's horse to one fitted with a screw adjustment.

The stand illustrated herewith has been found most useful at a gold-silver mine in central Mexico. It is of simple design and inexpensive to make, the essential parts being constructed from scrap materials. Briefly explained, it consists of a standard made from 2½-in. pipe and attached to a heavy pipe flange by means of a reduction, and a 1-in. steel rest. The latter is adjusted to the desired height by putting the lower bent end through one of the holes in the flat section of the standard. These holes are drilled about 1 in. apart, and should be made at an angle not exceeding 30 deg., so as to insure a safe hold of the shank when weight is placed upon the rest. The hole in the head of the standard through which the shank of the rest slides up and down must be made large enough to allow for the movement of the shank when its lower end is being taken out or being put through any of the holes in the standard.







## A Tailings Disintegrator

SIMPLICITY in design and operation are the outstanding features of the disintegrator or "puddler" employed at the Gold Road mill of the United States Smelting, Refining and Mining Company, Gold Road, Arizona, for preparing old tailings for the crushing department of the plant. The materials are scraped from dumps below the mill to a 150-ton storage bin by a Sauerman Bros. scraper installation, from which it is evenly fed to the simple disintegrator that is shown in the accompanying sketch.

The device essentially consists of a redwood tank and a screen support made from 1-in. pipe, welded, using screens with ½x1-in. openings. Wood particles and other debris can be removed quickly through a clean-out door installed level with the screen in the circular wall of the tank, and a rubber ring prevents rock and sand particles from being washed between the tank wall and the screen support. Two steel handles on the screen support facilitate its removal from the bottom of the tank. The material dumped into the tank is washed through the screen by a stream of high-pressure solution (50 lb. pressure) and goes to the classifier in the grinding department. Operating and maintenance costs are exceptionally low because of absence of moving or complicated mechanical parts. The information presented was kindly supplied by Paris Brough, mill superintendent.

*Summary of the*

# MARKETS

WITH the trend of industrial activity during June pointing upward, and London prices fairly steady, sentiment in the domestic market for non-ferrous metals improved. Consumers have reduced their inventories since the first of the year to the point where a steady flow of new buying has set in for copper, lead, and zinc. Believing that production of metals will be reduced this summer, unfavorable statistics occasioned little comment of a bearish character.

Domestic sales of copper for the month of June amounted to 66,381 tons, which compares with 59,519 tons in May. The price held at 10c., Valley, throughout the month, and so-called "outside" copper did not occupy a prominent place in the way of new bookings during the period. The fact that London parity moved up close to the domestic basis encouraged both buyers and sellers. The opinion was held by many in the industry that 10c. will mark bottom for the year. Domestic consumption of copper is expected to expand moderately over the remainder of the year. The import tax on copper was continued to June 30, 1941.

Lead sales were large and a moderate improvement in London prices gave producers an opportunity to raise the domestic quotation 10 points to the basis of 4.85c., New York. The position of zinc remained unchanged, with producers hopeful that the tariff question may yet received favorable attention from the Department of State.

Silver jumped into the limelight late in June as the Senate opposed the monetary bill and the entire silver purchase program was threatened. The uncertainty over silver caused the foreign price to drop to 37⅜c., New York, the lowest level since 1933.

The International Tin Committee raised export quotas for the third quarter 5 per cent, establishing the rate at 45 per cent of standard tonnages. The London market advanced to close to the upper limit of £230 for spot standard.

## UNITED STATES MARKET

| 1939 June | Electrolytic Copper—Domestic (a) Refinery | Electrolytic Copper—Export (b) Refinery | Straits Tin New York | Lead New York | Lead St. Louis | Zinc St. Louis |
|---|---|---|---|---|---|---|
| 1 | 9.775 | 9.825 | 49.000 | 4.75 | 4.60 | 4.50 |
| 2 | 9.775 | 9.825 | 49.000 | 4.75 | 4.60 | 4.50 |
| 3 | 9.775 | 9.825 | 49.000 | 4.75 | 4.60 | 4.50 |
| 5 | 9.775 | 9.850 | 48.900 | 4.75 | 4.60 | 4.50 |
| 6 | 9.775 | 9.825 | 48.750 | 4.75 | 4.60 | 4.50 |
| 7 | 9.775 | 9.825 | 48.750 | 4.75 | 4.60 | 4.50 |
| 8 | 9.775 | 9.800 | 48.700 | 4.75 | 4.60 | 4.50 |
| 9 | 9.775 | 9.775 | 48.500 | 4.75 | 4.60 | 4.50 |
| 10 | 9.775 | 9.775 | 48.500 | 4.75 | 4.60 | 4.50 |
| 12 | 9.775 | 9.750 | 48.300 | 4.75 | 4.60 | 4.50 |
| 13 | 9.775 | 9.650 | 48.400 | 4.75 | 4.60 | 4.50 |
| 14 | 9.775 | 9.675 | 48.700 | 4.80 | 4.65 | 4.50 |
| 15 | 9.775 | 9.675 | 48.725 | 4.80 | 4.65 | 4.50 |
| 16 | 9.775 | 9.675 | 48.725 | 4.80 | 4.65 | 4.50 |
| 17 | 9.775 | 9.675 | 48.750 | 4.80 | 4.65 | 4.50 |
| 19 | 9.775 | 9.675 | 49.000 | 4.85 | 4.70 | 4.50 |
| 20 | 9.775 | 9.700 | 49.100 | 4.85 | 4.70 | 4.50 |
| 21 | 9.775 | 9.725 | 49.125 | 4.85 | 4.70 | 4.50 |
| 22 | 9.775 | 9.725 | 49.100 | 4.85 | 4.70 | 4.50 |
| 23 | 9.775 | 9.675 | 49.100 | 4.85 | 4.70 | 4.50 |
| 24 | 9.775 | 9.700 | 49.100 | 4.85 | 4.70 | 4.50 |
| 26 | 9.775 | 9.700 | 49.000 | 4.85 | 4.70 | 4.50 |
| 27 | 9.775 | 9.700 | 49.000 | 4.85 | 4.70 | 4.50 |
| 28 | 9.775 | 9.700 | 48.950 | 4.85 | 4.70 | 4.50 |
| 29 | 9.775 | 9.700 | 49.000 | 4.85 | 4.70 | 4.50 |
| 30 | 9.775 | 9.775 | 49.000 | 4.85 | 4.70 | 4.50 |
| **AVERAGES FOR MONTH** | | | | | | |
| | 9.775 | 9.738 | 48.853 | 4.800 | 4.650 | 4.500 |
| **AVERAGES FOR WEEK** | | | | | | |
| June | | | | | | |
| 7 | 9.775 | 9.829 | 48.900 | 4.750 | 4.600 | 4.500 |
| 14 | 9.775 | 9.738 | 48.517 | 4.758 | 4.608 | 4.500 |
| 21 | 9.775 | 9.688 | 48.904 | 4.825 | 4.675 | 4.500 |
| 28 | 9.775 | 9.700 | 49.042 | 4.850 | 4.700 | 4.500 |
| **CALENDAR WEEK AVERAGES** | | | | | | |
| June | | | | | | |
| 3 | 9.775 | 9.808 | 49.000 | 4.750 | 4.600 | 4.500 |
| 10 | 9.775 | 9.808 | 48.683 | 4.750 | 4.600 | 4.500 |
| 17 | 9.775 | 9.683 | 48.600 | 4.783 | 4.633 | 4.500 |
| 24 | 9.775 | 9.700 | 49.088 | 4.850 | 4.700 | 4.500 |

## SILVER, GOLD, AND STERLING EXCHANGE

### NEW YORK AND LONDON

| 1939 June | Sterling Exchange "Checks" | Sterling Exchange "90-day demand" | Silver (c) New York | Silver London | Gold London | Gold (d) United States |
|---|---|---|---|---|---|---|
| 1 | 4.681250 | 4.666875 | 42.750 | 19.9375 | 148s 5d | $35.00 |
| 2 | 4.681875 | 4.667500 | 42.750 | 20.0000 | 148s 5d | 35.00 |
| 3 | 4.682500 | 4.668125 | (e) | 19.9375 | 148s 5d | 35.00 |
| 5 | 4.683750 | 4.669375 | 42.750 | 20.0000 | 148s 4½d | 35.00 |
| 6 | 4.684375 | 4.660000 | 42.750 | 20.0000 | 148s 4d | 35.00 |
| 7 | 4.683750 | 4.660000 | 42.750 | 19.9375 | 148s 4d | 35.00 |
| 8 | 4.682500 | 4.668750 | 42.750 | 19.9375 | 148s 5d | 35.00 |
| 9 | 4.681875 | 4.667500 | 42.750 | 19.8750 | 148s 5d | 35.00 |
| 10 | 4.682500 | 4.668750 | (e) | 19.8125 | 148s 5d | 35.00 |
| 12 | 4.683125 | 4.669375 | 42.750 | 19.8125 | 148s 5d | 35.00 |
| 13 | 4.684375 | 4.670000 | 42.750 | 19.8750 | 148s 4d | 35.00 |
| 14 | 4.682500 | 4.667500 | 42.750 | 19.9375 | 148s 5d | 35.00 |
| 15 | 4.680000 | 4.662500 | 42.750 | 19.8750 | 148s 5½d | 35.00 |
| 16 | 4.680000 | 4.662500 | 42.750 | 19.7500 | 148s 6½d | 35.00 |
| 17 | 4.681250 | 4.663750 | (e) | 19.6875 | 148s 6d | 35.00 |
| 19 | 4.681250 | 4.664375 | 42.750 | 19.6250 | 148s 6d | 35.00 |
| 20 | 4.681250 | 4.665625 | 42.750 | 19.1250 | 148s 5½d | 35.00 |
| 21 | 4.680000 | 4.664375 | 42.750 | 19.0000 | 148s 5½d | 35.00 |
| 22 | 4.680000 | 4.663750 | 42.750 | 19.2500 | 148s 6d | 35.00 |
| 23 | 4.678750 | 4.662500 | 42.750 | 19.4375 | 148s 6d | 35.00 |
| 24 | 4.680000 | 4.663750 | (e) | 19.6250 | 148s 6d | 35.00 |
| 26 | 4.679375 | 4.663125 | 42.750 | 19.6250 | 148s 6d | 35.00 |
| 27 | 4.681250 | 4.665000 | 39.750 | 18.9375 | 148s 6d | 35.00 |
| 28 | 4.680000 | 4.663750 | 38.250 | 18.1875 | 148s 6½d | 35.00 |
| 29 | 4.678750 | 4.660625 | 37.750 | 17.9375 | 148s 6½d | 35.00 |
| 30 | 4.679375 | 4.658125 | 37.750 | 18.0000 | 148s 6d | 35.00 |
| Average for Mo. | 4.68137 | ..... | 41.955 | 19.505 | ..... | 35.00 |
| **AVERAGES FOR WEEK** | | | | | | |
| June | | | | | | |
| 7 | 4.68292 | ..... | 42.750 | ..... | ..... | ..... |
| 14 | 4.68281 | ..... | 42.750 | ..... | ..... | ..... |
| 21 | 4.68063 | ..... | 42.750 | ..... | ..... | ..... |
| 28 | 4.67990 | ..... | 41.250 | ..... | ..... | ..... |

Calendar week averages: New York Silver June 3d, 42.750; 10th, 42.750; 17th, 42.750; 24th, 42.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1939, the U. S. Government's price on newly mined domestic silver was continued at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛c. per ounce throughout June.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

# PRICES OF METALS • MISCELLANEOUS QUOTATIONS

## LONDON MARKET

| 1939 | COPPER | | | TIN | | LEAD | | | | ZINC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electro | Standard | | Spot | | 3 months | | Spot | | 3 months | |
| June | Spot | 3 months | Bid | Spot | 3 months | Buyers | Sellers | Buyers | Sellers | Buyers | Sellers | Buyers | Sellers |
| 1..... | 42.4375 | 42.8125 | 48.0000 | 226.7500 | 224.5000 | 14.5000 | 14.5625 | 14.7500 | 14.8125 | 14.0000 | 14.0625 | 14.2500 | 14.3125 |
| 2..... | 42.3750 | 42.7500 | 48.3750 | 227.0000 | 224.5000 | 14.6250 | 14.6875 | 14.8750 | 14.9375 | 14.1250 | 14.1875 | 14.3750 | 14.4375 |
| 5..... | 42.3750 | 42.7500 | 48.5000 | 226.2500 | 224.0000 | 14.5000 | 14.5625 | 14.6875 | 14.7500 | 14.0000 | 14.1250 | 14.2500 | 14.3125 |
| 6..... | 42.1875 | 42.5000 | 47.7500 | 225.5000 | 223.2500 | 14.3125 | 14.3750 | 14.5000 | 14.5625 | 14.0000 | 14.1250 | 14.2500 | 14.3125 |
| 7..... | 42.3125 | 42.6250 | 48.5000 | 225.7500 | 223.5000 | 14.3750 | 14.4375 | 14.5625 | 14.6250 | 14.1250 | 14.1875 | 14.3125 | 14.4375 |
| 8..... | 42.1250 | 42.5000 | 47.7500 | 225.5000 | 223.0000 | 14.3750 | 14.4375 | 14.5000 | 14.5625 | 14.0625 | 14.1250 | 14.2500 | 14.3125 |
| 9..... | 41.8750 | 42.1875 | 47.5000 | 225.0000 | 222.5000 | 14.4375 | 14.5625 | 14.5625 | 14.6250 | 14.1250 | 14.1875 | 14.2500 | 14.3125 |
| 12..... | 41.6250 | 41.9375 | 47.2500 | 224.2500 | 222.0000 | 14.3750 | 14.4375 | 14.3750 | 14.4375 | 14.1250 | 14.1875 | 14.1875 | 14.2500 |
| 13..... | 41.3750 | 41.7500 | 46.7500 | 224.5000 | 222.2500 | 14.3125 | 14.3750 | 14.3125 | 14.3750 | 13.9375 | 14.0625 | 14.0625 | 14.1250 |
| 14..... | 41.8750 | 42.1875 | 47.2500 | 227.5000 | 225.0000 | 14.5625 | 14.6875 | 14.6875 | 14.7500 | 14.0000 | 14.0625 | 14.1875 | 14.2500 |
| 15..... | 41.4375 | 41.7500 | 47.0000 | 227.0000 | 224.5000 | 14.4375 | 14.5000 | 14.5000 | 14.5625 | 13.7500 | 13.8125 | 14.0000 | 14.0625 |
| 16..... | 41.5000 | 41.8750 | 47.0000 | 227.2500 | 224.5000 | 14.5625 | 14.6250 | 14.5625 | 14.6250 | 13.6875 | 13.8125 | 14.0000 | 14.0625 |
| 19..... | 41.7500 | 42.0625 | 47.0000 | 227.7500 | 224.7500 | 14.6875 | 14.7500 | 14.6875 | 14.7500 | 13.8750 | 14.0000 | 14.1250 | 14.1875 |
| 20..... | 41.8750 | 42.1875 | 47.2500 | 228.7500 | 225.0000 | 14.7500 | 14.8125 | 14.7500 | 14.8125 | 14.0625 | 14.1875 | 14.2500 | 14.3125 |
| 21..... | 42.1875 | 42.5000 | 47.5000 | 229.2500 | 225.0000 | 14.7500 | 14.8125 | 14.8125 | 14.8750 | 14.0000 | 14.0625 | 14.1875 | 14.2500 |
| 22..... | 42.0625 | 42.3125 | 47.5000 | 229.0000 | 224.7500 | 14.6250 | 14.6875 | 14.7500 | 14.8125 | 13.7500 | 13.8750 | 14.0000 | 14.0625 |
| 23..... | 41.8125 | 42.1250 | 47.0000 | 229.7500 | 224.7500 | 14.5625 | 14.6875 | 14.7500 | 14.8125 | 14.0000 | 14.1875 | 14.2500 | 14.3125 |
| 26..... | 42.0000 | 42.3125 | 47.2500 | 229.5000 | 224.5000 | 14.6250 | 14.6875 | 14.6875 | 14.7500 | 14.1875 | 14.2500 | 14.3750 | 14.4375 |
| 27..... | 42.0000 | 42.3125 | 47.5000 | 229.7500 | 224.0000 | 14.5625 | 14.6875 | 14.5625 | 14.6875 | 14.0000 | 14.0625 | 14.1875 | 14.2500 |
| 28..... | 42.0000 | 42.3750 | 47.2500 | 229.7500 | 224.2500 | 14.5000 | 14.5625 | 14.5000 | 14.6250 | 13.8750 | 13.9375 | 14.1250 | 14.1875 |
| 29..... | 42.1875 | 42.5000 | 47.5000 | 229.7500 | 224.2500 | 14.4375 | 14.5625 | 14.5000 | 14.5625 | 13.8750 | 13.9375 | 14.1250 | 14.1875 |
| 30..... | 42.3125 | 42.6875 | 48.2500 | 229.7500 | 224.2500 | 14.6875 | 14.7500 | 14.6875 | 14.7500 | 13.9375 | 14.0625 | 14.1875 | 14.2500 |
| Average for Month.. | 41.986 | ..... | 47.528 | 227.511 | ..... | 14.564 | | 14.651 | | 14.023 | | 14.223 | |

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb

## CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(July 1, 1939)

### MISCELLANEOUS METALS

| | |
|---|---|
| **Aluminum,** ingot, 99 plus per cent, lb | 20c. |
| **Antimony,** domestic, spot, lb | 12.00c. |
| **Bismuth,** ton lots, lb | $1.10 |
| **Cadmium,** commercial sticks, lb | 50c. |
| **Calcium,** lb., ton lots 97 @ 98 per cent | 75c. |
| **Chromium,** 97 per cent grade, lb | 85c. |
| **Nickel,** electrolytic cathodes, lb | 35c. |
| **Magnesium,** 99.8 per cent, carolads, lb | 28c. |
| **Palladium,** troy oz | $24.00 |
| **Platinum,** (Official quotation) troy oz | $35.00 |
| **Quicksilver,** flask of 76 lb., 100 flasks or more | $88.00@$91.00 |
| **Radium,** mg. radium content | $25.00@$30.00 |
| **Selenium,** 99.5 per cent, lb | $1.75 |
| **Silicon,** minimum 97 per cent, spot, lb | 16.50c. |
| **Tellurium,** lb | $1.75 |
| **Thallium,** 100 lb. or more, lb | $6.50 |
| **Titanium,** 96 to 98 per cent, lb | $5.00 |

### METALLIC ORES

| | |
|---|---|
| **Beryllium Ore,** f.o.b. mines, ton | $30.00@$35.00 |
| **Chrome Ore,** 48 @ 50% $Cr_2O_3$ c.i.f. Atl. ports, long ton | $19.50@$20.50 |
| **Iron Ore,** Lake Superior, Lower Lake ports, long ton: | |
| Old Range bessemer | $5.25 |
| Mesabi bessemer | $5.10 |
| Old Range non-bessemer | $5.10 |
| Mesabi, non-bessemer | $4.95 |
| **Lead** (Galena) 80 per cent, Joplin, Mo., ton | $52.50@$57.50 |
| **Manganese Ore,** c.i.f. Atlantic ports, long ton unit of Mn: | |
| 52 @ 55 per cent | 29c. |
| 50 @ 52 per cent | 28c. |
| 44 @ 48 per cent | 24c. |
| **Molybdenum Ore,** 90 per cent, per lb. of contained $MoS_2$ | 45c. |
| **Tungsten Ore,** per unit of $WO_3$: | |
| Chinese, 65 per cent, duty paid | $18.00 |
| Domestic, 65 per cent and upward | (a)$16.00@$17.00 |
| **Vanadium Ore,** per lb. of contained $V_2O_5$ | 27½c. |
| **Zinc Ore,** Prime, 60 per cent concentrate, Joplin, Mo.; per ton | $30.00 |

(a) Prices at mines, small lots, usually several dollars less.

### METALLIC COMPOUNDS

| | |
|---|---|
| **Arsenious Oxide** (arsenic) lb | 3c |
| **Cobalt Oxide,** 70 @ 71 per cent, lb | $1.67@$1.77 |
| **Copper Sulphate,** 100 lb | $4.15 |
| **Sodium Nitrate,** ex vessel, in 200-lb. bags, per 100 lb | $1.42 |
| **Sodium Sulphate,** bulk ton | $13.00@$15.00 |

### ALLOYS

| | |
|---|---|
| **Berrylium Copper,** master alloy, 2.5 to 3 per cent Be, per lb. of contained Be | $15.00 |
| **Ferrochrome,** 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb | 10½c. |
| **Ferromanganese,** 78 @ 82 per cent, gross ton | $80.00 |
| **Ferromolybdenum,** 55 @ 65 per cent Mo. lb. of Mo. contained | 95c. |
| **Ferrosilicon,** 50 per cent, gross ton | $69.50 |
| **Ferrotungsten,** 75 @ 80 per cent, lb. of W contained | $1.60 |

### NON-METALLIC MINERALS

| | |
|---|---|
| **Asbestos,** f.o.b. mines, ton: | |
| Canadian (Quebec) | |
| Crude No. 1 | $700@$750 |
| Crude No. 2 | $150@$350 |
| Spinning fibers | $110@$200 |
| Paper stock | $40@$45 |
| Shorts | $12@$16.50 |
| Vermont | |
| Shingle stock | $57 |
| Paper stock | $40 |
| Cement stock | $25 |
| **Barytes,** long ton: | |
| Georgia, crude | $7.00 |
| Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron | $6.00@$7.00 |
| **Bauxite,** long ton: | |
| Domestic, chemical, 55 @ 58 per cent | $6.00@$7.00 |
| Domestic, abrasive, 80 @ 84 per cent | $12.00@$14.00 |
| Dalmatian, 50 @ 55 per cent | (a)$6.00@$7.00 |
| French, 56 @ 59 per cent | (a)$7.00@$8.00 |
| **China Clay,** f.o.b. mines, ton: | |
| South Carolina and Georgia, No. 1, bulk | $6.75@$8.00 |
| Delaware, No. 1 | $14.50 |
| **Feldspar,** bulk, ton: | |
| Potash feldspar, 200 mesh | $17.00 |
| Glass-spar, white, 20 mesh | $11.75 |
| **Fluorspar,** f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton | $18.00 |
| **Fuller's earth,** f.o.b. Georgia or Florida, ton | $7.00@$14.00 |
| **Magnesite,** per ton: | |
| Dead-burned, f.o.b. California | $25.00 |
| Dead-burned, f.o.b. Washington | $22.00 |
| **Mica,** per lb., North Carolina, No. 1 and 2 quality: | |
| 1½ x 2 in | 25@30c. |
| 2 x 2 in | 40@50c. |
| 3 x 3 in | $1.00@$1.20 |
| 3 x 4 in | $1.30@$1.40 |
| 3 x 5 in | $1.50@$1.70 |
| White, ground, 70 mesh, ton | $60.00@$80.00 |
| **Ocher,** Georgia, ton | $19.00@$22.00 |
| **Pyrites,** Spanish, per long ton unit of S, c.i.f. Atlantic ports | 12c. |
| **Silica,** in bags, 325 mesh, ton | $18.00@$40.00 |
| **Sulphur,** Texas mines, long ton | $16.00 |
| **Talc,** f.o.b. works, ton: | |
| New York, double air-floated, 325 mesh | $12.00@$15.00 |
| New Jersey, mineral pulp | $8.00@$10.00 |
| Vermont, extra white, 200 mesh | $9.00@ $9.50 |
| **Tripoli,** Missouri, ton: | |
| 40 mesh, cream colored | $14.50 |
| 200 mesh, cream colored | $26.00 |

### IRON AND STEEL

| | |
|---|---|
| **Pig Iron,** Valley furnaces, gross ton: | |
| Bessemer | $21.50 |
| Basic | $20.50 |
| No. 2 Foundry | $21.00 |
| **Steel,** base prices, Pittsburgh: | |
| Billets, gross ton | $34.00 |
| Structural shapes, 100 lb | $2.10 |
| Bars, 100 lb | $2.15 |

*Monthly and Yearly*

# AVERAGE PRICES

## SILVER AND STERLING EXCHANGE

| | New York | | London Spot | | Sterling Exchange | |
|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1938 | 1939 | 1938 | 1939 |
| January | 44.750 | 42.750 | 19.895 | 20.305 | 499.895 | 466.775 |
| February | 44.750 | 42.750 | 20.159 | 20.370 | 501.722 | 468.472 |
| March | 44.446 | 42.750 | 20.088 | 20.280 | 498.394 | 468.370 |
| April | 42.750 | 42.750 | 18.880 | 20.031 | 498.046 | 467.778 |
| May | 42.750 | 42.750 | 18.731 | 20.123 | 496.673 | 467.988 |
| June | 42.750 | 41.955 | 18.945 | 19.505 | 495.772 | 468.137 |
| July | 42.750 | ..... | 19.356 | ..... | 492.855 | ..... |
| August | 42.750 | ..... | 19.389 | ..... | 488.044 | ..... |
| September | 42.750 | ..... | 19.300 | ..... | 480.240 | ..... |
| October | 42.750 | ..... | 19.613 | ..... | 476.785 | ..... |
| November | 42.750 | ..... | 19.834 | ..... | 470.587 | ..... |
| December | 42.750 | ..... | 20.083 | ..... | 466.798 | ..... |
| Year | 43.225 | ..... | 19.523 | ..... | 488.818 | ..... |

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

## COPPER

| | F.O.B. Refinery, Electrolytic | | | | London Spot | | | |
|---|---|---|---|---|---|---|---|---|
| | Domestic | | Export | | Standard | | (a) Electrolytic | |
| | 1938 | 1939 | 1938 | 1939 | 1938 | 1939 | 1938 | 1939 |
| January | 10.198 | 11.025 | 9.908 | 9.912 | 41.387 | 43.125 | 45.387 | 48.440 |
| February | 9.775 | 11.025 | 9.525 | 9.735 | 39.597 | 42.188 | 43.563 | 47.375 |
| March | 9.775 | 11.025 | 9.496 | 9.888 | 39.772 | 42.938 | 43.582 | 48.120 |
| April | 9.775 | 10.265 | 9.443 | 9.820 | 39.306 | 42.031 | 43.408 | 47.833 |
| May | 9.375 | 9.833 | 8.801 | 9.738 | 36.668 | 41.656 | 40.852 | 47.528 |
| June | 8.775 | 9.775 | 8.500 | 9.738 | 35.235 | 41.986 | 39.417 | 47.528 |
| July | 9.585 | ..... | 9.573 | ..... | 39.744 | ..... | 44.405 | ..... |
| August | 9.900 | ..... | 9.844 | ..... | 40.591 | ..... | 45.909 | ..... |
| September | 10.028 | ..... | 9.943 | ..... | 41.864 | ..... | 47.148 | ..... |
| October | 10.760 | ..... | 10.713 | ..... | 45.646 | ..... | 51.190 | ..... |
| November | 11.025 | ..... | 10.569 | ..... | 45.244 | ..... | 51.080 | ..... |
| December | 11.025 | ..... | 10.023 | ..... | 43.428 | ..... | 48.988 | ..... |
| Year | 10.000 | ..... | 9.695 | ..... | 40.707 | ..... | 45.411 | ..... |

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

## LEAD

| | New York | | St. Louis | | London | | | |
|---|---|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1938 | 1939 | 1938 Spot | 1938 3 mos. | 1939 Spot | 1939 3 mos. |
| January | 4.870 | 4.826 | 4.720 | 4.676 | 16.135 | 16.253 | 14.534 | 14.744 |
| February | 4.632 | 4.805 | 4.482 | 4.655 | 15.402 | 15.525 | 14.283 | 14.417 |
| March | 4.500 | 4.824 | 4.350 | 4.674 | 15.992 | 16.075 | 14.660 | 14.860 |
| April | 4.500 | 4.782 | 4.350 | 4.632 | 15.579 | 15.623 | 14.337 | 14.533 |
| May | 4.400 | 4.750 | 4.250 | 4.600 | 14.210 | 14.376 | 14.483 | 14.679 |
| June | 4.148 | 4.800 | 3.998 | 4.650 | 13.969 | 14.012 | 14.564 | 14.651 |
| July | 4.882 | ..... | 4.732 | ..... | 14.921 | 15.034 | ..... | ..... |
| August | 4.900 | ..... | 4.750 | ..... | 14.371 | 14.480 | ..... | ..... |
| September | 4.998 | ..... | 4.848 | ..... | 15.249 | 15.401 | ..... | ..... |
| October | 5.100 | ..... | 4.950 | ..... | 16.173 | 16.313 | ..... | ..... |
| November | 5.091 | ..... | 4.941 | ..... | 16.088 | 16.223 | ..... | ..... |
| December | 4.842 | ..... | 4.692 | ..... | 15.106 | 15.275 | ..... | ..... |
| Year | 4.739 | ..... | 4.589 | ..... | 15.266 | 15.383 | ..... | ..... |

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

## TIN

| | Straits New York | | Standard, Spot London | |
|---|---|---|---|---|
| | 1938 | 1939 | 1938 | 1939 |
| January | 41.548 | 46.404 | 183.619 | 215.435 |
| February | 41.373 | 45.640 | 183.144 | 213.906 |
| March | 41.219 | 46.213 | 183.473 | 215.375 |
| April | 38.430 | 47.160 | 168.612 | 218.389 |
| May | 36.885 | 49.031 | 162.693 | 225.591 |
| June | 40.376 | 48.853 | 177.429 | 227.511 |
| July | 43.428 | ..... | 192.542 | ..... |
| August | 43.276 | ..... | 192.966 | ..... |
| September | 43.369 | ..... | 193.733 | ..... |
| October | 45.263 | ..... | 206.911 | ..... |
| November | 46.262 | ..... | 213.909 | ..... |
| December | 46.180 | ..... | 214.450 | ..... |
| Year | 42.301 | ..... | 189.457 | ..... |

New York quotations cents per pound. London, pounds sterling per long ton.

## ZINC

| | St. Louis | | London | | | |
|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1938 Spot | 1938 3 mos. | 1939 Spot | 1939 3 mos. |
| January | 5.000 | 4.500 | 14.994 | 15.173 | 13.682 | 13.887 |
| February | 4.813 | 4.500 | 14.408 | 14.589 | 13.522 | 13.780 |
| March | 4.417 | 4.500 | 14.364 | 14.477 | 13.728 | 13.961 |
| April | 4.141 | 4.500 | 13.729 | 13.919 | 13.443 | 13.637 |
| May | 4.042 | 4.500 | 12.682 | 12.869 | 13.717 | 13.938 |
| June | 4.131 | 4.500 | 12.890 | 13.104 | 14.023 | 14.223 |
| July | 4.745 | ..... | 14.144 | 14.371 | ..... | ..... |
| August | 4.750 | ..... | 13.467 | 13.675 | ..... | ..... |
| September | 4.846 | ..... | 14.040 | 14.246 | ..... | ..... |
| October | 5.012 | ..... | 15.083 | 15.232 | ..... | ..... |
| November | 4.924 | ..... | 14.366 | 14.550 | ..... | ..... |
| December | 4.500 | ..... | 13.709 | 13.861 | ..... | ..... |
| Year | 4.610 | ..... | 13.990 | 14.172 | ..... | ..... |

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

## CADMIUM AND ALUMINUM

| | Cadmium | | | Aluminum | |
|---|---|---|---|---|---|
| | 1938 (a) | 1939 (a) | 1939 (b) | 1938 | 1939 |
| January | 117.500 | 70.900 | 58.400 | 20.000 | 20.000 |
| February | 117.500 | 67.500 | 55.000 | 20.000 | 20.000 |
| March | 117.500 | 65.278 | 54.259 | 20.000 | 20.000 |
| April | 102.500 | 52.500 | 50.000 | 20.000 | 20.000 |
| May | 102.500 | 52.500 | 50.000 | 20.000 | 20.000 |
| June | 102.500 | 52.500 | 50.000 | 20.000 | 20.000 |
| July | 102.500 | ..... | ..... | 20.000 | ..... |
| August | 99.722 | ..... | ..... | 20.000 | ..... |
| September | 84.000 | ..... | ..... | 20.000 | ..... |
| October | 80.000 | ..... | ..... | 20.000 | ..... |
| November | 77.717 | ..... | ..... | 20.000 | ..... |
| December | 72.500 | ..... | ..... | 20.000 | ..... |
| Year | 98.037 | ..... | ..... | 20.000 | ..... |

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound; (a) average of producer's and plater's quotations; (b) producers' price, commercial sticks.

## ANTIMONY, QUICKSILVER, AND PLATINUM

| | Antimony (a) New York | | Quicksilver (b) New York | | Platinum (c) New York | |
|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1938 | 1939 | 1938 | 1939 |
| January | 13.750 | 11.670 | 79.240 | 77.440 | 36.000 | 34.440 |
| February | 13.750 | 11.250 | 76.455 | 85.227 | 36.000 | 35.000 |
| March | 13.750 | 11.269 | 72.444 | 87.278 | 36.000 | 35.000 |
| April | 13.654 | 11.500 | 71.019 | 90.800 | 36.000 | 35.000 |
| May | 12.460 | 11.712 | 74.640 | 86.769 | 33.400 | 35.000 |
| June | 11.731 | 12.000 | 80.731 | 86.615 | 33.231 | 35.000 |
| July | 11.030 | ..... | 76.860 | ..... | 36.000 | ..... |
| August | 10.880 | ..... | 75.500 | ..... | 37.000 | ..... |
| September | 11.310 | ..... | 74.420 | ..... | 39.000 | ..... |
| October | 12.060 | ..... | 73.480 | ..... | 37.960 | ..... |
| November | 12.250 | ..... | 74.065 | ..... | 36.217 | ..... |
| December | 11.567 | ..... | 76.769 | ..... | 34.000 | ..... |
| Year | 12.349 | ..... | 75.469 | ..... | 35.901 | ..... |

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk deduct .250c. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum is dollars per ounce troy.

## PIG IRON

| | Bessemer | | Basic | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1938 | 1939 | 1938 | 1939 | 1938 | 1939 |
| January | 24.50 | 21.50 | 23.50 | 20.50 | 24.00 | 21.00 |
| February | 24.50 | 21.50 | 23.50 | 20.50 | 24.00 | 21.00 |
| March | 24.50 | 21.50 | 23.50 | 20.50 | 24.00 | 21.00 |
| April | 24.50 | 21.50 | 23.50 | 20.50 | 24.00 | 21.00 |
| May | 24.50 | 21.50 | 23.50 | 20.50 | 24.00 | 21.00 |
| June | 23.73 | 21.50 | 22.73 | 20.50 | 23.23 | 21.00 |
| July | 20.50 | ..... | 19.50 | ..... | 20.00 | ..... |
| August | 20.50 | ..... | 19.50 | ..... | 20.00 | ..... |
| September | 20.50 | ..... | 19.50 | ..... | 20.00 | ..... |
| October | 21.50 | ..... | 20.50 | ..... | 21.00 | ..... |
| November | 21.50 | ..... | 20.50 | ..... | 21.00 | ..... |
| December | 21.50 | ..... | 20.50 | ..... | 21.00 | ..... |
| Year | 22.686 | ..... | 21.686 | ..... | 22.186 | ..... |

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

# PERSONAL ITEMS

**Charles H. Smith,** of Clifton, Ariz., recently joined the staff of the Philippine Smelting Company.

**Edward Wisser** has been engaged in professional work in the vicinity of Auburn, Calif, recently.

**M. D. Garretty** has been appointed chief geologist of North Broken Hill, Ltd., Broken Hill, N. S. W.

**J. S. Kaserman** has joined the staff of the United States Vanadium Corporation, Bishop, Calif., as chief chemist.

**John McDermid** has been appointed secretary of the British Institution of Mining Engineers. He became a member of the staff of the Institution in 1925 and had been acting secretary since 1932.

**H. Foster Bain,** who had been in the United States for several weeks, sailed for Europe on June 14 on the "Aquitania" on his way to Manila.

**S. H. Ross** has been retained by the Quebec Bureau of Mines to give technical advice to prospectors and operators in the Province of Quebec.

**George S. Gluck,** mining engineer, recently went to Arizona on professional business. He expects to return to New York about the middle of July.

**Nils E. Nilsen,** general manager of Emperor Gold Mining Company, N. L., will assume the management of the Loloma property also.

**F. W. R. Godden,** general manager of Loloma (Fiji) Gold Mines, N. L., since 1936, has resigned to go with Bulolo Gold Dredging, Ltd., New Guinea.

**Richard Longanecker** has left Hammonton, Calif., where he was with Yuba Consolidated, to join the staff of Coco Grove Consolidated, in the Philippines.

**R. Beresford Ash,** underground manager of Great Boulder Proprietary Gold Mines, Ltd., Kalgoorlie, W. A., left on an overseas visit during April.

**Arthur J. Perry** has resigned his position as superintendent of Mina del Tajo, Rosario, Sinaloa, Mexico, to become manager with Mina del Cote, Cosala, Sinaloa, where he will direct the construction of a 50-ton concentration and cyanidation mill.

**James R. Hobbins,** executive vice-president of Anaconda Copper Mining Company, has been elected a director of Greene Cananea Copper Company, succeeding the late J. W. Allen.

**Samuel H. Hoyt,** formerly a director of metallurgical research for the A. C. Smith Corporation, has become a member of the staff of the Battelle Memorial Institute, Columbus, Ohio.

**Dr. J. H. Marsman,** chairman of the board of Marsman & Company, of Manila, and executive head of the Marsman-managed companies, was in New York for a few days in June, stopping at the Waldorf-Astoria. In commenting on the mining situation in the Philippines, he said that gold production was steadily mounting, his own group of companies having achieved a

DR. J. H. MARSMAN

new high in May, with an output of $775,000, as compared with less than $500,000 in the same month last year. In his opinion, new properties are still to be had in the Islands. In the last six months three have been taken up by his company. The various projects mentioned by Dr. Marsman include the erection of a 300-ton mill, to be completed in September; the testing of a placer deposit in Sumatra; and a dredging venture in Burma that will call for three dredges.

**Dr. J. K. Gustafson,** who for three years has been in charge of a geological examination of the Broken Hill, N. S. W., ore deposits, left on return to the U.S.A., via England, in April.

**Edward Salveson,** formerly connected with Cia. Min. Maguarichic, S. A., Maguarichic, Chihuahua, as mine superintendent, is now mine superintendent with Cia. Min. de Eleanora, S. A., Sabinal, Chihuahua.

**George Lauri** has been appointed general manager of the Kalgurli Ore Treatment Company, Kalgoorlie, W. A., succeeding **A. F. B. Norwood. G. A. Walker** has been made metallurgist for the company.

**Dr. H. C. Gunning,** of the Bureau of Geology and Topography, Department of Mines and Resources, Ottawa, has been appointed to the staff of the University of British Columbia at Vancouver as professor of geology.

**W. Bemis Phelps,** who has resigned as general manager of Tom Reed Gold Mines Company, Oatman, Ariz., has been appointed consulting engineer for the Mountain King mine, at Copperopolis, Calif.

**J. A. Westaway** has been appointed mill superintendent of Triton Gold Mines, N. L., Reedy, W. A., in succession to **H. H. Dunkin,** who has joined the staff of Melbourne University as senior lecturer in mining and metallurgy.

**M. G. Hearn,** of the department of geology of the University of the Witwatersrand, Johannesburg, South Africa, is on a six months' trip to the mining districts of the United States and Canada.

**Walter Hovey Hill,** old-time mining engineer of Grangeville, Idaho, has been engaged by a group of men in Yakima and Seattle, Wash., to examine the property of the Penman Mining Corporation, in Idaho County, Idaho.

**John S. Stewart,** who for some months has been in London in a consulting capacity with Trepca Mines, Ltd., has gone to the company's property in Yugoslavia, where a lead smelter is being erected. His address will be Posta Zvecan.

**I. H. Wynne** is still in Peru, South America, where he is consulting engineer for the Peruvian-owned gold mining companies, Nacional, Nazca, Saramarca, Parcoy, Buldibuyo, Caraveli, and Alpacay. His headquarters are Lampa 645, Lima.

**Professor G. A. Roush,** editor for many years of *The Mineral Industry,* has been awarded the Toulmin Medal of the Society of American Military Engineers for his series of articles on strategic military supplies.

**A. M. Richmond** has been appointed managing director of Reward Mining Company, operating the Surf Point and Edye Pass mines, on Porcher Island, British Columbia. He is also continuing his private practice as a consulting mining engineer.

**J. E. Manners,** general manager of Boulder Perseverance, Ltd., at Kalgoorlie, W. A., is on a business trip to Great Britain. **Ian D. Cameron** will act as general manager of the company during Mr. Manners' absence.

**John A. Murphy,** formerly mine superintendent for the Guanajuato Reduction & Mines Company, Guanajuato, Mexico, has been appointed general manager of Lane-Rincon Mines, Inc., Mina Rincon via Toluca, Mexico. He succeeds **H. C. Enos,** now at Chatsworth, Calif.

**Dr. Claude E. Needham** has been made president of the New Mexico School of Mines, succeeding **Dr. Edgar Herbert Wells,** deceased. Dr. Needham joined the faculty of the school in 1931 as assistant professor of geology, advancing to associate professor and full professorship, and then to presidency of the institution.

**Otto D. Rohlfs,** consulting mining engineer of Seattle, Wash., and recently general manager of Quail Gold Mines, Inc., at Coulterville, Calif., is now consulting engineer for Alaska-Pacific Consolidated Mining Company in the Willow Creek district, Alaska. He may be addressed at Wasilla, Alaska.

**Marshall L. Havey** has been elected a vice-president of the New Jersey Zinc Company and its subsidiaries. **Ralph M. Neumann** has been made general sales manager. He will continue as manager of the pigment division of the New Jersey Zinc Sales Company. **Arthur E. Mervine** has been appointed assistant general sales manager. He will continue as manager of the metal division of the company.

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# OBITUARY

**Alfred A. Amos,** a pioneer of the Cobalt district, died on June 7 in Toronto. He was 59 years old.

**John H. Allen,** metallurgist, died at Greenwich, Conn., on June 5, at the age of 78.

**Thomas E. Fisher,** mining engineer, died recently in Hackensack, N. J. He was 56 years old.

**William H. Goldsworthy,** mining engineer, died in Alameda, Calif., on May 19 at the age of 47.

**Maurice Denn,** director of the Shattuck Denn Mining Corporation of Arizona, died recently at Redondo Beach, Calif., aged 84.

**Randolph Eisenhauer,** consulting engineer of Berkeley, Calif., died in that city on May 24, aged 53. He was a graduate of the University of California in 1913.

**George Wesley Worthington,** a well-known mining man of the West, died at Grass Valley, Calif., on April 26 at the age of 60.

**Edgar Protheroe Jones,** long prominent in mining circles in Western Australia, died recently in Surrey, England, at the age of 79.

**Harry Howard Webb,** mining engineer, at one time manager of the Rhodes properties in South Africa, died on June 2 at Montecito, Calif., at the age of 85.

**Fred Hodges,** mill superintendent of the Chino mines division of Nevada Consolidated Copper Corporation, died on June 11 at Santa Barbara, Calif., at the age of 60.

**Samuel A. Steier,** 48, operator of the Yankee mine in the American Fork Mining Canyon district, died at his Salt Lake home June 14.

**Robert J. Glendinning,** 72, manager of the R. J. Glendinning Company, distributors of mining machinery at Salt Lake City died at his home on June 8.

**Charles H. Strawbridge,** 66, president of Goodman Manufacturing Company, died in Chicago, Ill., May 15, after a brief illness. He had been associated with the company 39 years, having been appointed secretary in 1900.

**Thomas F. Cole,** long a prominent mining man, and formerly associated with Charles M. Schwab in the United States Steel Corporation, as well as with the Phelps Dodge Copper Company, died in Pasadena, Calif., on June 3. Mr. Cole was 77. He had extensive mining interests in Nevada, California and Arizona.

**Walter Hazen Eardley,** manager of smelter and mills of the United States Smelting, Refining & Mining Company of the Utah district for many years, died at Salt Lake City, Utah, on June 19, at the age of 57. Mr. Eardley had also been district manager in the Joplin field for the American Metal Company and was for some years in New York City as a consulting engineer.

**Abbot A. Hanks,** San Francisco metallurgist, assayer, and chemist, and president of Abbot A. Hanks, Inc., died at his home in San Francisco on June 17 at the age of 70. He was a member and past president of the San Francisco Engineers' Club, a member of the American Institute of Mining and Metallurgical Engineers, American Chemical Society, Society of Chemical Industry, and American Society for Testing Materials.

**Ernst Edward Marshall,** whose demise was reported recently, had worked in Australia and had a prominent part in the development of mineral industries of Peru and Chile. For the past eighteen years he was chairman of the board of Anglo Metal Company, a wholly owned subsidiary of American Metal.

**R. C. Eisenhauer,** consulting mining engineer of Berkeley, Calif., died on May 24 at the age of 53. He was graduated from the College of Mines of the University of California in 1914, and from that time until his death he was engaged in mine operation and professional examinations throughout the West, latterly chiefly along the Mother Lode in California.

▼ ▼ ▼

# A LETTER

## Geophysical Prospecting in American Mining

*The Editor:*

I BELIEVE the readers of *Engineering & Mining Journal* might be interested in the following excerpts from a letter received by me recently from S. F. Kelly, Geophysical Explorations, Ltd., Toronto, Canada, and pertaining to my article on geophysics published in the April issue.

Mr. Kelly states: "Although I realize you were confining your attention to geophysics in America, I think that credit should be given to Robert W. Fox for originating the spontaneous polarization method by his work in Cornwall in the eighteen thirties. Dr. Carl Barus was merely taking a leaf from Fox's notebook . . . He (Dr. Barus) did *not* succeed in making spontaneous polarization measurements on the Comstock Lode, but had to transfer his experiment to Eureka, Nev. . . . Some of the work for determining the depth to bedrock in New York and New England for the United States Army Engineers was done in 1936. Additional work for the Army Engineers was done in 1937."

Likewise, W. X. Osborn writes from the Philippines as follows:

"I note that you have left out entirely what was probably the first commercial application of electrical prospecting methods in the United States, the work done in 1901-1903 by the Electro-Geodetic Mining Company, of Los Angeles, Calif. The instrument used was developed and patented by a telephone engineer in Long Beach (I believe his name was Brown). The instrument was described in an issue of *Scientific American* and a description given of its principles.

"It was based on measuring electrical resistance and used a bridge consisting of either german silver or platinum wire, with scale that gave resistance in ohms. The first work was done in and around Randsburg, Calif., and was successful in locating faulted sections of veins near the stringer district.

"Late in 1902 the company sent a party to Tonopah. This party was in charge of a man named Peter William Wright, who happened to have a large financial interest in the patent. At that time, it was generally believed in Tonopah, that, if veins could be located under the various porphyry flows, they would be productive. I was young and enthusiastic over the possibilities of the survey and did not realize its limitations. The first survey was for the O'Meara Lynch Company on the King Tonopah ground. I located and mapped a vein that I reported as occurring at a depth of 400 ft. Later a shaft was sunk to reach this vein and it went through the flows and hit the apex of the vein. It contained only low-grade pyrite, and, as I remember it, the values were around five dollars per ton.

"The next survey was on the North Star ground. They had not found ore yet, but the survey and plotting of the resistances gave very definite evidences of a vein. The shaft was at that time down over 300 ft., if I recollect correctly, and I had a hole drilled in the bottom and took a reading of the resistance between that point and my main station and got a remarkably low resistance. I predicted that they were close to ore (which was a lucky statement on my part, although based on the reading), and they broke into pay ore three days after I made my report.

"I next made a survey of the McNamara and believe that later developments in both the latter properties showed that the veins developed followed veins marked on my maps as probable veins and ore bodies.

"Much work was done by the company in Tonopah, and they bought a mining property themselves on the strength of their survey. About this time I became connected with the O'Meara Lynch Company and lost track of the developments of the Electro-Geodetic Survey organization."

I hope that some scientific or professional organization will find it possible to make an exhaustive study of the application of geophysics in mining along the lines followed in the article of mine referred to.

V. G. GABRIEL

**E & M J Weighted Index of Non-Ferrous Metal Prices**

(100 is composite for 1922-3-4)

| | | | |
|---|---|---|---|
| 1929 | 110.33 | 1934 | 65.56 |
| 1930 | 82.87 | 1935 | 74.66 |
| 1931 | 60.20 | 1936 | 73.45 |
| 1932 | 48.26 | 1937 | 90.86 |
| 1933 | 59.79 | 1938 | 73.67 |

| | 1937 | 1938 | 1939 |
|---|---|---|---|
| January | 87.03 | 75.56 | 77.12 |
| February | 91.68 | 73.43 | 76.89 |
| March | 103.78 | 72.41 | 77.09 |
| April | 98.62 | 71.19 | 74.79 |
| May | 93.25 | 69.15 | 73.61 |
| June | 93.21 | 67.55 | 73.17 |
| July | 93.82 | 72.95 | .... |
| August | 95.28 | 73.94 | .... |
| September | 94.33 | 74.70 | .... |
| October | 85.26 | 77.61 | .... |
| November | 78.91 | 78.36 | .... |
| December | 75.18 | 77.13 | .... |

# What Metal Statistics Show

METAL STATISTICS have shown little improvement during the last two months, but production has kept about in line with consumption, and with sentiment on the general business outlook improving, the mining industry should stand to gain in the remaining months of the year. The foreign situation will, however, continue to inject periods of apprehension among producers, but so far prices of metals have remained firm. The *E.&M.J.* index of non-ferrous metal prices declined slightly during June, from 73.61 in May to 73.17.

Copper statistics are expected to show improvement in the third quarter after the usual summer curtailment has been in effect.

A summary of the April and May statistics of the Copper Institute, in short tons, follows:

| | April | May |
|---|---|---|
| Production, crude: | | |
| U. S. mine | 48,749 | 47,759 |
| U. S. scrap, etc. | 13,799 | 10,817 |
| Foreign mine | 86,486 | 90,606 |
| Foreign scrap | 11,173 | 15,840 |
| Totals | (a)160,207 | 165,022 |
| Production, refined: | | |
| United States (b) | 58,368 | 68,536 |
| Foreign | 107,940 | 101,936 |
| Totals | 166,308 | 170,472 |
| Deliveries, refined: | | |
| U. S. domestic | 42,484 | 45,961 |
| U. S. exports (b) | 4,183 | 12,669 |
| Foreign | 107,011 | 113,666 |
| Totals | 153,678 | 172,296 |
| Stock at end, refined: | | |
| United States | 322,513 | 342,419 |
| Foreign | 190,209 | 178,479 |
| Totals | 522,722 | 520,898 |

(a) Corrected. (b) Duty-free copper.

▶ ZINC—The April, May and June statistics of the American Zinc Institute, covering all grades, are summarized as follows, in tons.

| | Apr. | May | June |
|---|---|---|---|
| Stock at beginning | 127,985 | 130,380 | 133,075 |
| Production | 43,036 | 42,302 | 39,450 |
| Production daily rate | 1,435 | 1,365 | 1,315 |
| Shipments | 40,641 | 39,607 | 37,284 |
| Unfilled orders | 29,314 | 29,250 | 35,874 |
| Stock at end | 130,380 | 133,075 | 135,241 |

Figures covering operations of the Prime Western division, for April, May, and June, follow:

| | Apr. | May | June |
|---|---|---|---|
| Stock at beginning | 56,522 | 57,558 | 58,808 |
| Production | 20,152 | 19,756 | 17,881 |
| Shipments | 19,116 | 18,506 | 17,483 |
| Stock at end | 57,558 | 58,808 | 59,206 |

▶ LEAD—Stocks of lead increased in May owing to an adjustment in the figures on production of lead from domestic ore. The increase was 5,876 tons. Producers were unanimous in stating that there had been no gain in mine production.

The refined-lead statistics for April and May, in short tons, according to the American Bureau of Metal Statistics, follow:

| | April | May |
|---|---|---|
| Stock at beginning | 122,035 | 123,394 |
| Production: | | |
| Domestic ore | 36,704 | 43,026 |
| Secondary and foreign | 2,546 | 2,980 |
| Totals | 39,250 | 46,006 |
| Domestic shipments | 37,903 | 40,124 |
| Stock at end | 123,394 | 129,270 |

World production of refined lead during April was 161,587 tons, which compares with 159,969 tons in March and 142,777 tons in February. Resumption of refining operations in Mexico accounted for most of the gain in production in April.

▶ SILVER—Output of refined silver for the world in the first four months of 1939 has been holding at about the same rate as in 1938. Output on a refinery basis for the Jan.-April period, excluding Mexico, amounted to 60,020,000 oz., against 58,581,000 oz. in the same period last year, the American Bureau of Metal Statistics reports. Statistics on Mexico's operations cover only the first two months of the current year, in which period 11,075,000 oz. was produced.

The United States produced 5,336,000 oz. of silver in April, making the total for the first four months 20,340,000 oz., against 21,101,000 oz. in the same time last year.

Silver production of the world in the Jan.-April period of both 1938 and 1939, in ounces, follows:

| | Jan.-April 1938 | Jan.-April 1939 |
|---|---|---|
| United States | 21,101,000 | 20,340,000 |
| Canada | 6,516,000 | 6,077,000 |
| Mexico | 31,762,000 | (a) |
| Peru | 5,881,000 | 6,725,000 |
| Other America | 5,790,000 | 5,950,000 |
| Europe | 6,505,000 | 7,180,000 |
| Australia, etc. (b) | 4,710,000 | 4,944,000 |
| Japan (c) | 3,300,000 | 3,500,000 |
| Burma, refined | 2,010,000 | 2,140,000 |
| Other Asia | 1,120,000 | 1,570,000 |
| South Africa | 373,000 | 374,000 |
| Belgian Congo | 975,000 | 790,000 |
| Other Africa | 200,000 | 430,000 |
| Totals | 90,343,000 | (a) |
| Totals, ex Mexico | 58,581,000 | 60,020,000 |

(a) Not yet reported. (b) Australia and New Zealand. (c) Estimated.

▶ GOLD—Production of gold for the world during April, excluding Russia, amounted to 2,734,000 oz., which compares with 2,785,000 oz. in March. Production during the first four months of 1939, excluding Russia, totaled 10,836,000 oz., against 9,900,000 oz. in the same period last year, according to the American Bureau of Metal Statistics.

## Chrome Ore Industry in the United States

The annual summary of the chrome ore industry in the United States, by the United States Bureau of Mines, states that domestic production of ore, as measured by shipments from the mines, decreased from 2,321 long tons in 1937 to only 812 tons in 1938. The entire domestic output came from California. Owing to the recession in business, imports of chromite dropped from 553,916 tons in 1937 to 352,085 tons in 1938. The statistics of the industry for a period of years follow:

| | 1925-29 Average | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Apparent available supply: | | | | | | |
| Imports, long tons | 224,357 | 192,297 | 259,063 | 324,258 | 553,916 | 352,085 |
| Domestic shipments, long tons | 276 | 369 | 515 | 269 | 2,321 | 812 |
| Totals | 224,633 | 192,666 | 259,578 | 324,527 | 556,237 | 352,897 |
| Price per long ton (a) | $22.46 | $19.00 | $17.70 | $17.76 | $22.55 | $21.59 |
| Imports, per cent of total: | | | | | | |
| Africa (b) | 63 | 26 | 36 | 37 | 50 | 48 |
| Cuba | 15 | 26 | 18 | 22 | 17 | 11 |
| Greece | 9 | 12 | 8 | 8 | 5 | 3 |
| New Caledonia | 6 | 10 | 22 | 20 | 9 | 8 |
| Turkey | ..... | 15 | 6 | 6 | 7 | 6 |
| U. S. S. R. | ..... | 10 | 1 | 1 | ..... | ..... |
| Other countries | 7 | 1 | 9 | 6 | 12 | (c)24 |
| World production, long tons | 428,000 | 589,000 | 780,000 | 1,051,000 | (d) | (d) |

(a) Approximate average of all grades, New York. (b) Originated in Southern Rhodesia and Union of South Africa. (c) Principally from Philippines. (d) Not yet available.

*Boston California Mining Company, operating the Malvina mine near Coulterville, is making plans to increase daily production to 100 tons.*

ores removed by power shovels is being considered. C. R. Brown, superintendent, is in charge of operations.

▶ According to an announcement of Judge Chas. W. Slack, president of Mariposa Commercial & Mining Company, an option for the purchase of about 10,000 acres of the Fremont Grant has been granted to the San Rosario Mining Company, headed by A. R. Gordon, 1710 Hoban Road, Washington, D. C. Included in the holding are such mines as the Princeton, Mount Ophir, Mother's, Long Mary, and Elisabeth. Mr. Gordon made a preliminary examination of the properties about a year ago.

▶ The Saratoga Mining Association has completed plans for the installation of a small Straub mill at its property near Murphy, Calaveras County, following development of commercial ore to a depth of 50 ft. The mine is opened by a two-compartment shaft, and contains four veins varying from 6 to 20 in. in width.

# CALIFORNIA

## San Carlos Quicksilver Mine to Be Rehabilitated

**New Idria Quicksilver Mining Company plans development of old cinnabar property — Dredge equipped with resoiling device will operate soon near Oroville**

▶ Rehabilitation work is being pushed at the old San Carlos quicksilver mine, 2 miles southeast of Idria, San Benito County, a part of the holdings of the New Idria Quicksilver Mining Company, of San Francisco, where a power shovel has been put to work recently to strip old workings and the old shaft is being cleared to a depth of 300 ft. preparatory to developing known cinnabar veins. Mining operations at the New Idria property are conducted on a two-shift basis, with the two rotary furnaces at the reduction plant handling 180 tons of screened material a day. Monthly quicksilver production ranges from 400 to 500 flasks, and 150 men are given employment. Henry W. Gould, with offices in the Mills Building, San Francisco, is general manager, and C. Hyde Lewis, superintendent, directs operations at Idria.

▶ Upon completion of the gold placer dredge now under construction at Oakland at an estimated cost of $80,000, the Golden Feather Dredging Company, headed by E. A. Wiltsee, of San Francisco, will start dredging the north bank of the Feather River opposite the town of Oroville. It is understood that fourteen land-owners in this territory have contracted with the mining company on a royalty basis, requiring that the land be left in agricultural condition after removal of the gold values. Accordingly, the new dredge will be fitted with resoiling equipment. Later, a contract may be entered into with the town of Oroville to dredge the south bank of the river.

▶ Argonaut Mining Company, Jackson, Amador County, has placed in operation the new 500-ton plant completed recently at Plymouth to treat accumulated tailings at the Plymouth Consolidated Mines property acquired a few years ago by the company for $75,000. The tailings are removed from the dumps by hydraulic methods and receive subsequent treatment in a trash screen, two 10x10-ft. Devereux agitators, ten 56-in. Fagergren flotation cells, two 44-in. Fagergren cleaner cells, and a 3x4-ft. Oliver filter, with an 8-in. Grigsby valve controlling the flotation feed. Finished concentrates are shipped to the Selby smelter, and the flotation tailings are sent to a Dorr bowl classifier for sand-slime separation, with the slimes going to waste and the sands being leached in six 34x12-ft. tanks. Pregnant solutions are treated in a Merrill-Crowe precipitation plant. Alex. F. Ross is general superintendent of the Argonaut Mining Company, and Hal M. Lewers is in charge of the tailings treatment plant.

▶ A second dragline dredge has been placed in operation by the General Dredging Corporation at the Mississippi Bar placer holdings near Folsom. Daily production of the new installation consisting of a 1-yd. dragline and a washing plant resting on a pontoon-type steel hull averages 2,000 cu.yd. The 2-yd. unit installed last year handles 4,000 cu.yd. of gold-bearing gravel a day, and the dragline dredge operating near San Andreas has a capacity of 2,000 cu.yd. per day. W. H. Haines and J. O. Greenan are president and vice-president respectively, with Ace Giddins in charge of dredging operations.

▶ Good progress is being made in the construction of a 600-ton sand-leaching cyanide plant at the property of Santa Fe Gold Mines, Inc., in Black Hawk Canyon about 35 miles southeast of Victorville, San Bernardino County. The mill is expected to be placed in operation sometime in August. R. K. Voorhies is manager, and about 120 men are employed at present.

▶ Rehabilitation work is being carried on at the Jumper and Golden Rule mines, near Jamestown. Tuolumne County, leased recently by the Briganti brothers, of Santa Barbara. The old Jumper shaft is being dewatered to the 600-ft. level as a preliminary to extensive underground development. Installation of a 500-ton mill to treat surface

# ARIZONA

## Phelps Dodge Corporation Donates Mines Building

**Structure given to University of Arizona expected to be ready early in 1940 — Producers Mines, Inc., takes option on silver properties — Monte Cristo mine being rehabilitated for early production**

▶ P. G. Beckett, vice-president of the Phelps Dodge Corporation, announced on May 31 that the corporation's board of directors is prepared to donate to the University of Arizona necessary funds for the construction and equipment of a new mining engineering building to be placed on the University campus. Plans, specifications, and a construction contract are to be subject of approval of the corporation. The building will be named in honor of Dr. John Douglas, who was responsible for most of the corporation's expansion program. Mr. Beckett said: "Our corporation has a particular if somewhat selfish interest in the full development of your mining and engineering departments. Our operations require the services of highly trained technical men. As far as possible we should like to supply our needs in that regard from the graduates of the University." Ore dressing machinery and other metallurgical equipment which the school of mines does not have will be installed in the new building. Dr. Atkinson, president of the University, accepted the gift on behalf of the board of regents and faculty.

▶ M. B. Dudley, of Kingman, associated with Dr. N. H. Morrison, of Phoenix, recently took over the Monte Cristo mine, at Constellation. The property was developed years ago by Ezra W. Thayer and produced some high-grade silver ores. In 1926 the property was operated by C. C. Julian for a short period. It then became entangled in litigation, and Mr. Dudley and associates acquired it through a court purchase in receivership. Mr. Brooks announces that the property will be rehabilitated at once. It is adequately equipped with machin-

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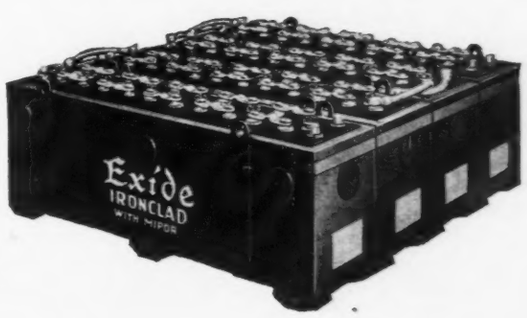


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*Twenty-ton trucks haul ore from this pit at the United Verde branch of the Phelps Dodge Corporation, Jerome, Arizona. The bottom is 30 ft. below the 600-ft. level of the mine.*

## ▶ARIZONA

ery and camp facilities and little preliminary work is required before starting operations.

▶ Producers Mines, Inc., of Chloride, operating the 220-ton mill at the old Pilgrim property, has taken an option on the White Hills silver properties and is making an examination of the property. If results of the examination are satisfactory, and the domestic silver price is maintained, the company will begin the movement of ores to its mill pending the probable installation of a new milling plant on the White Hills properties. In the late 90's and early in this century the White Hills is credited with production of several millions in silver ores. At one time there were several hundred leasers working on the property, and many made fortunes. The property has been tied up in litigation for some years but was recently unraveled and the title perfected.

▶ Around 40 tons of ore are being produced daily from the old Fortuna mine, 30 miles southeast of Yuma. A small amalgamating plant is treating 25 tons daily. The property is leased to H. C. and C. F. Burton, of Rosamond, Calif. W. M. Maitland, of Yuma, is superintendent and about 15 men are employed.

▶ Between 30 to 40 tons of ore are being produced daily at the Continental mine, near Globe. The property is being operated by Mines, Inc. S. D. Gardam is manager. Mr. Gardam lives in Miami. The present 400-ft. shaft is being sunk another 200 ft. and drifting will be started soon from the lower levels to connect known oreshoots. This company also controls the Florence Lead-Silver mine, at Kelvin. Mines, Inc., is headed by J. Norman Phillips. 418 South Normandie St., Los Angeles, Calif. Dr. A. Clyde More, 133 West Woodlawn, San Antonio, Tex., is chief geologist for the company.

▶ Back Bone Mining Company, near Arivaca, is producing about four tons of gold ore daily. The drifts on the 60 and 80 levels are in commercial ore. The shaft is down to a depth of 135 ft. New equipment is being installed on the property, including an air compressor and jackhammers. Houston L. Walsh, Home Builders Building, Phoenix, is president of the company. Claude Clays is mine superintendent.

▶ The Western mine, recently taken over by the Vivian Mining Company, at Oatman, is making daily shipments of ore to the mill and cyanide plant of the company at the Vivian mine. Arthur E. Dirrim is superintendent of the property.

▶ Keystone Copper Mining Company, at Dragoon, has encountered a heavy flow of water in its shaft and has installed pumping facilities. A 250-ton flotation plant is planned for treatment of the ores and installation is expected to commence at an early date. The ores contain copper, zinc, molybdenum, and silver. U. R. Miller, of Dragoon, is president and general manager.

▶ Liberty Hill Gold Mines, Ltd., operating the Alvarado mine, near Congress, has announced its repayment of its two RFC loans, a Class B loan of $20,000 and a Class A loan of $70,000, two years before the amounts were due. The company is stated to have paid off both loans from the profits of eleven months of operations. The plant is handling 85 tons of ore daily. The property has recently been equipped with a new cyanide plant. L. L. Farnham, of Congress, is directing the operations at the mine and mill.

▶ The Desert mine, owned by Dr. C. D. Lesher, of Vicksburg, has leased the property to Clark Rhodehand. A new shaft has been started and shipments are expected to commence soon. Ore will go to the Harrisburg mill.

▶ Dragoon Mining Corporation has fourteen men working at the Extension mine. A small tonnage of tungsten ore is being produced and the ores are jigged before shipment. Don Douglas, of Benson, is superintendent. Walter J. Six, 820 Occidental Building, Indianapolis, Ind., is president of the corporation.

▶ The 100-ft. shaft at the Cora mine, 11 miles west of Wickenburg, has been completed and crosscuts are now being driven to cut the two veins containing gold-silver ore.

## UTAH

### Government Agencies to Conduct Health Survey

**Workers in mining industry to be examined, so that a satisfactory basis of compensation for occupational diseases can be determined by State Legislature — Elton Tunnel reaches lower horizons of Bingham district**

▶ A survey to determine the industrial hazards to health in the Utah mining industry will be started on July 1 by three governmental agencies—the United States Public Health Service, the Utah State Industrial Commission, and the State Board of Health. Dr. J. L. Jones, Utah public health commissioner, has secured a two years' leave of absence to direct the survey in cooperation with J. J. Bloomfield, United States public health engineer. Dr. Jones takes the place of Dr. R. R. Jones, United States public health surgeon of Washington, D. C., who died in Salt Lake City after an operation for appendicitis on June 10. Three thousand workers in the coal, the metal mining, and the metallurgical industries will be examined. Data accumulated are to be submitted in the form of a report to the Utah State Legislature of 1941 as the basis of a law providing compensation for occupational diseases.

▶ Tooele celebrated on June 16 the driving of the Elton Tunnel into the lower horizons of the Bingham district by the National Tunnel & Mines Company of the International Smelting & Refining Company. Five thousand citizens and visitors took part in a program consisting of a parade, flag drill, athletic events, and dancing. Mayor Nelse Blomstrom was chairman. William E. Ryberg, Salt Lake contractor, made the address of the day. Dr. L. A. McBride was in charge of the parade, A. G. Gowans, marshal and B. G. Sweet, general chairman of arrangements.

▶ The Tintic Gold Mining Company has begun operations on the 400 and 500 levels of its Tintic property to develop main fissures of the system east of the shaft. J. L. Mitchell and Ray Rasmussen, of Park City, have the contract to do the development. J. J. Beeson, mining geologist, is directing operations.

▶ Marble quarries near Pelican Point on the west shore of Utah Lake are being reopened by the Onyx Corporation of America. The marble is suitable, officers report, for the making of fountain-pen desk sets and ornamental lamps.

▶ On receipt of a $65,000 loan from RFC, the Salt Lake Sodium Products began the expansion of its plant on the shores

DORRCO

*We commend to the thoughtful consideration of American engineers and manufacturers the following extracts from a recent radio address of the same title over the Columbia Broadcasting System by Mr. W. J. Cameron of the Ford Motor Company.*

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"False social reform would take the little stock of wealth already created and tear at it until nothing is left—diverting energy to *division* that ought to be used for *production.* We easily recognize the folly of *that.* ‹‹‹‹‹‹ "When certain types of business men madly scramble for a market already developed, and tear at that until nothing is left, instead of reaching out and developing new markets, they practice the same folly . . . The root fallacy in both is the desire to *take* instead of *make,* the belief that we can get by *division* what we can get only by expansion.

"Wasteful contests in business and elsewhere arise because it is easier to imitate than to try to create . . . . . A man develops an idea that proves to be practical and profitable . . . . . thousands rush to imitate what he has done. ‹‹‹‹ "This is entirely proper if the participation of those thousands is required for the service the original idea should give . . . . . Competition that results in an improved article or a better service or a more equitable price is always justifiable . . . . . But a mad battle for the same dollar, that is not competition.

"Setting up another peanut stand on a corner where one peanut stand is already competently and completely serving the trade, that is not competition . . . It is not business expansion either . . . It is a division and subtraction—*decrease!* ‹‹‹‹ "The salesman and manufacturer 1939 depends on are those who are in their particular business because they have a natural affinity for it, and would rather do for less money what they are doing now than get more money for doing something else . . . These are the men whose business watchword always is "Expand."

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## ▶UTAH

of Great Salt Lake near Saltair, to a capacity of 100 tons daily. The money will be used to construct a new power plant and purchase of new equipment including a classifier, centrifugal machine, evaporator, drier, trackage, locomotive, and improved loading machinery.

▶ Rapid progress is being made on construction of the new United States Bureau of Mines experiment station at the University of Utah, Salt Lake City. Foundations for the $225,000 building will be completed by July 1 and the new plant ready for occupancy by Jan. 1, 1940. Designed by Lewis Telle Cannon, Salt Lake architect, the station will consist of two independent buildings connected by an inclosed ramp. On the west will be a three-story office and laboratory building, 40 by 133 ft. long. The shop building to the east will be of one story, 182x100 ft. Both buildings will be constructed of reinforced concrete, brick, and cast-stone trim. The shop buildings will contain the machine shop, an instrument shop, hydrometallurgy and non-ferrous metallurgy laboratories, instrument shop, a chemical control room, a garage and a boiler room. The first floor of the office building will be devoted to offices and a shipping room. An elevator will connect the first floor with the laboratories, drafting rooms, library, and photographic dark rooms on the other floors.

### AMERICAN MINING CONGRESS CONVENES AUG. 28-31

*PLANS for the Western Division meeting of the American Mining Congress to be held at Salt Lake City Aug. 28-31 were discussed at a conference held in the Kerns Building Salt Lake City, Utah, on June 6. Julian D. Conover, secretary of the national organization, and his assistant, P. C. McMurrer, arrived from Washington, D. C., to outline the program with A. G. Mackenzie, secretary of the Utah Chapter, and members of the Committee, F. S. Mulock, chairman; J. O. Elton, O. N. Friendly, James Ivers, D. D. Moffat, W. J. O'Connor, James W. Wade, and C. T. Keighley. George H. Rupp, of Pueblo, Colo., manager of the mining division of the Colorado Fuel & Iron Company, presided at the meeting.*

▶ Thomas H. Kennedy, trial examiner for the National Labor Relations Board, Los Angeles, Calif., presided at a hearing of the NLRB held in Salt Lake City at the Federal Building June 9 to determine the status of employees transporting ore at the Bingham mine of the Utah Copper Company. The hearing followed filing of a complaint with the NLRB by the Brotherhood of Locomotive Firemen and Enginemen, contending that the company has refused to bargain collectively. The union claims to represent a majority of the employees engaged in ore-hauling at the Bingham property.

# IDAHO

## Sunshine Mining May Extend Jewell Shaft

**Development results on lower levels encourage plans for sinking shaft from 3,200 level to 3,700 ft. — Miners receive wage increase on new 71.11c. silver price**

▶ Stockholders of the Sunshine Mining Company received a quarterly dividend disbursement of 40c. per share on June 30. The payment was made to stockholders of record on June 15. This is the second disbursement this year of similar amount. The dividend totals $595,528 and makes the grand total paid by the company to date $16,793,899. The output for the second quarter of the year is understood to have been approximately the same as the first quarter, when the yield was 2,232,018 oz. silver, taken from 83,304 tons of mine ore. The mill is handling around 900 tons daily. The deep workings of the Sunshine, from 2,700 level down, are now in the Revette, having passed from the St. Regis to the Revette between the 2,700 and 2,900 levels. Manager Leisk reports that the ore is showing improvement as greater depth is attained in the Revette, following a lean portion in the transition zone between the two formations. He has stated also that there appears to be a rather rapid lengthening of the oreshoot to the west between the 2,700 and 3,100 levels. Exploration work is now under way on the 2,900 and 3,100 levels of the mine, and it is understood the Jewell shaft will soon be started from its present bottom of 3,260 to a new low mark of 3,700 ft.

Because of the uncertainty about the price of domestic silver after June 30, the Sunshine mine was shut down on that day. It reopened, however, on July 6, after Congress on the previous day had passed the bill establishing the price of newly mined domestic silver at 71.11c. per ounce. The company also announced on July 6 that wages for its 550 employees would be increased 25c. per day.

▶ The Polaris mine, in the Coeur d'Alenes, is developing a strong shoot of silver ore on the 2,300 level, according to President James F. McCarthy. The ore was encountered in the east drift after driving about 35 ft. from the station and is exposed close to 100 ft.

▶ Shaft sinking at the Silver Dollar, in the Coeur d'Alene mining district, has been completed. The bottom of the shaft is 2,100 ft. below the surface and at the same horizon as the 2,100-ft. level of the Polaris mine or the 1,100-ft. level of the Sunshine. The company has started ore pockets on the 1,700, 1,900 and 2,100 ft. levels. High-grade ore is reported developed on 1,700 and 1,900 ft. horizon and it is expected ore of similar character will be developed on the 2,100 ft. level.

▶ Operations at the Hope Silver-Lead Mines, at Clarkfork, continue to meet with encouragement, according to Albert M. Nash of Kellogg, president-manager of the company. A diamond-drill campaign has been under way to determine the location of the Elsie K. vein south of the Nordquist fault, which cuts through the property.

▶ The Custer Gulch Mining Company, in the Coeur d'Alene district, holding a lease on the Phil Lynch group of claims on the east fork of Pine Creek, recently installed a gas-driven compressor. Four men are now employed and another shift will be added soon, Manager Ferring reports.

▶ "While politicians talk about the necessity of developing Idaho's phosphate deposits," says E. M. Norris, manager of the phosphate plant at Conda, in Caribou County, "the private interests concerned are going ahead and doing the job despite heavy taxation and the threat of governmental monopoly." His company employs 86 men, who produce about 400 tons of raw phosphate every 24 hours. This rock is ground in the mill and then treated with sulphuric acid to make the commercial superphosphate used as a fertilizer.

▶ Of importance to the Coeur d'Alenes as well as the thousands of investors and others interested in the now famous silver belt of the district, is a preliminary report issued by the Idaho bureau of mines and geology, in cooperation with the United States Geological Survey, compiled by Philip J. Shenon and R. H. McConnel, of the Survey staff. Accompanying the report is a preliminary map which shows the fault systems, formations found in the various properties, and other data which will be of great help to operators and engineers.

▶ The Short Bar placer, 4 miles above Riggins on the Salmon River, has been bought by the Gravel Construction Company of Minneapolis. A gravel-washing plant for gold recovery will be erected, with E. F. Leese as manager and his son, Frank, as superintendent.

▶ Enough ore has been uncovered without further development at the Ima Mines Corporation tungsten property in Lemhi County to operate the present mill for at least ten years, W. P. Barrett, general manager, reports.

▶ At the annual meeting of the stockholders of the Metropolitan Mines Corporation, held in Wallace, the entire board of directors was reelected for the new year as follows: R. L. Brainard, Kellogg, president; John M. Gleason, Spokane, vice-president; Roy H. Kingsbury, secretary-treasurer; directors: M. M. Miller, Spokane; Mrs. Matt Baumgartner, Los Angeles. Manager Robert S. Merriam presented a detailed report of operations during the past year with recommendations for the future work. The shaft operations have occupied the principal part of the development program, the report showing 526 ft. of shaft work completed. In addition about 300 ft. of drifting has been accomplished on the No. 4 vein on the tunnel level during the past few months. It is planned further to explore the No. 4 vein when the shaft reaches the 700 level station, at which point the vein will be very near to the shaft on its dip to the south.

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# NEWS FROM Washington

*By Special Correspondent*

MONEY LEGISLATION of three sorts had to be enacted by Congress before July 1 or serious complications would follow. It is necessary to appreciate both the scope of this legislation, and the time limit on it, to understand the logrolling and political maneuvering which occurred during June, some of which is likely to continue until the end of the present session of Congress. The three monetary subjects were:

1. Tax legislation was necessary. Various levies expired by law July 1; and these had to be renewed or the Treasury would be losing at the rate of one-half billion dollars per year. Senator Harrison and other advocates of business-relief changes in tax laws insisted on having such items also included in the law before they would provide for the extension of excise and nuisance taxes needed by the Treasury.

2. The President's authority for use of the stabilization fund and for control of the gold value of the dollar expired under the old law on June 30. For international negotiations the President needed both these items. Congress was, therefore, forced into the bitter wrangle of silver, inflation, and related monetary matters, described below.

3. Relief appropriations were left until last by Congress. Some action by July 1 was imperative or all WPA and other similar activities would stop completely. Planning for the new fiscal year gave Congress its best opportunity for revising the relief program. The House took full advantage of this opportunity and provided a most drastic overhaul of policy, along with the restricted appropriations. The Senate, always more conservative in such matters, went along on the matter of law making, much of which had little or nothing to do with "appropriations" as such.

Underlying all this maneuvering of money matters was the rather obvious struggle between various factions within each party to provide for themselves the best basis for appeal to the voters in 1940. In other words, the decisions nominally fiscal in nature were actually political in purpose.

Monetary legislation, under No. 2, above, blew up in the President's face with a loud bang on June 30. This was in effect a premature Independence Day celebration by Congress. The only sure interpretation is that Congress was seeking to embarrass the President quite as much as trying to fix new silver, gold, or international-exchange legislation.

On July 5, however, the silver bloc achieved a good portion of its objective in realizing a higher price for domestic newly mined silver. The Senate voted approval of the conference report on the monetary bill continuing the President's authority to devalue the dollar from 59.06 to 50 per cent of its former value and regain control of the two billion dollar stabilization fund. Congress also approved the law that 71.11c. shall be paid indefinitely for domestic newly mined silver, and that the foreign silver buying program shall be continued. On July 6 the President signed the bill.

## Silver and Inflation

MINING STATE Senators again organized during June in an effort to secure strategic advantage for silver. The alliance became again one between those admittedly seeking inflation and those who were apparently striving only for direct aid to silver producers. All this was, of course, strategically timed so that the Western bloc could exert its pressure during the consideration of the bill to extend the President's power of the stabilization fund and the gold value of the dollar. Thus, there were tied together a variety of factors not otherwise associated either in economics or in mining thinking.

The proposal of Senator Thomas and his associates of greatest concern to the mining industry was that the Treasury be ordered to buy all domestically mined silver at $1.04 an ounce, instead of at the price of 64.64c. last fixed by the President. To widen the support which they hoped for, the group added a second silver provision intended to be attractive to agricultural state delegations. This proposed that foreign purchasers of wheat and cotton could pay for those agricultural commodities in silver and get credit for that metal at 25 per cent above the prevailing world price, but not exceeding $1.29 per ounce.

For the inflationists the original proposal provided not only continuance of silver buying and paper money issue at the inflated rate of $1.29 per ounce, but also required unrestricted silver buying in the effort to make this metal 25 per cent of the metallic reserve, and continued the authorization for the President to issue up to three billion dollars in greenbacks.

All of this legislative effort, essentially of a logrolling nature, had much more force because of the limited time available for final action. Naturally, all of the more conservative executive department groups opposed the tying together of such dissimilar money matters. But only a few had the temerity to go so far as to demand 50c. an ounce as the base price for newly mined domestic silver, as did Federal Reserve Board Chairman Eccles some weeks ago. Necessarily, the votes of individual Senators and Congressmen were based on political considerations, not on their own economic convictions.

## Silver Price Fixing

THE SILVER-PRICE problem, however, was used as a powerful lever by those who sought to take monetary authority away from President Roosevelt. It was only mildly connected *in fact* with money questions. But the loyalty of Western Senators to this silver bonus idea provided a manageable group for alliance with Senate Republicans. This combination, aided by a small number of conservative Democrats who really believed what they voted, was irresistible.

No one ever expected that the inflationists would get $1.04 as a price for newly mined domestic silver. What they get ultimately (perhaps before this is printed) will have been taken from an unwilling President and Treasury, if the price is more than 64.64c. Domestic producers will temporarily profit but can expect retaliatory measures by Roosevelt, Morgenthau, and Company when, and if, that firm again is in control of silver price fixing.

The Treasury will buy foreign silver at a price not greater than the London level, if the authority to make such purchases is not ultimately restricted by the bill which failed of enactment prior to the deadline of midnight, June 30. As a result, United States relations with Mexico, China, and a number of other countries were seriously disturbed.

Close analysis of the situation has led even those columnists normally anti-New Deal to express bitter criticism of the Senate. Seldom—never in recent years—has a Congressional group so brazenly muddled in international relations for domestic political purposes as in this case. The immediate results are unknown, and the long-time results altogether unpredictable. But it will take time to unscramble the tangled skein of international relations with silver-selling countries, especially with Mexico and the Orient.

When Congress and the President finally arranged the silver pricing law for the current fiscal year it was found that the price fixed was not retroactive to July 1. Consequently international damage cannot be readily corrected by any retroactive clauses.

## Small Mine Loans

A BILL proposing to help the operators of small mining properties was introduced late in May by Representative John R. Murdock of Arizona. It proposed to set up a Mines Finance Corporation, under the management of three practical metal mining commissioners. The corporation would be authorized to make loans to mining enterprises that would be repaid by royalties on the ore produced.

This project, it was claimed, would not at all interfere with R. F. C. mining loans. The purpose was rather to provide small operators with not more than $5,000 each to permit preliminary development work on the basis of which larger loans could then be sought through R.F.C. as the need was demonstrated.

This particular bill, which seems to have little prospect of consideration in Congress, is more or less typical of Washington thinking. The small business man must be moved into the New

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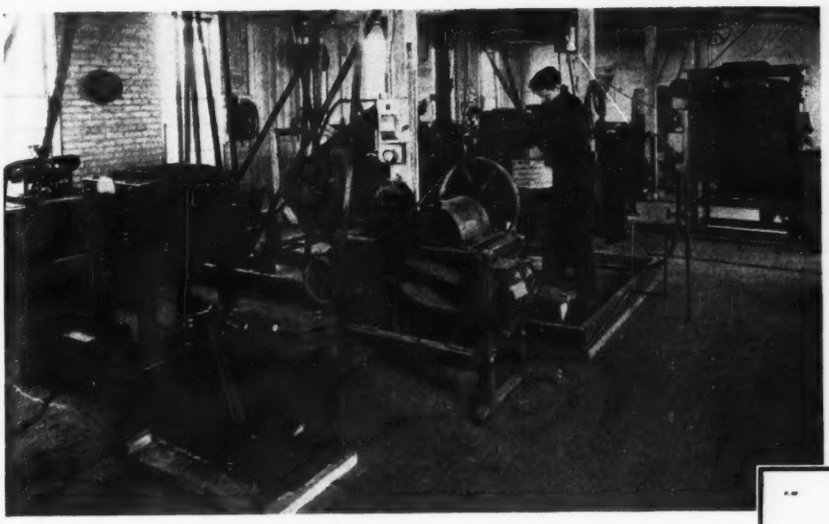

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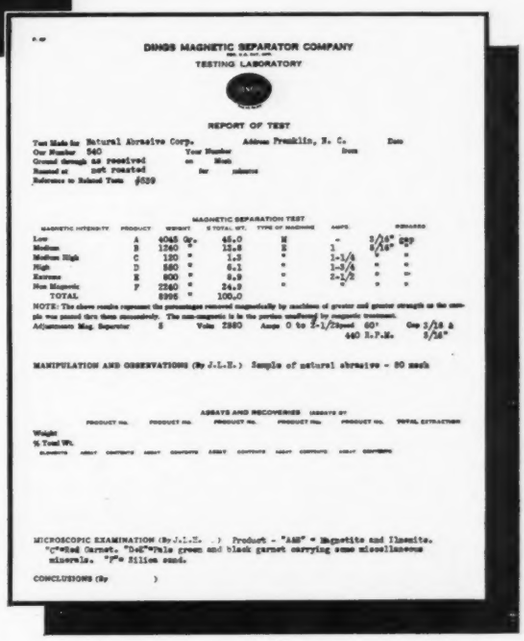

DINGS MAGNETIC SEPARATOR COMPANY
TESTING LABORATORY

REPORT OF TEST

Test Made for Natural Abrasive Corp. Address Franklin, N. C. Date
Our Number 540 Your Number Date
Ground through as received on Mesh
Roasted at not roasted for minutes
Reference to Related Tests #539

MAGNETIC SEPARATION TEST

| MAGNETIC INTENSITY | PRODUCT | WEIGHT | % TOTAL WT. | TYPE OF MACHINE | AMPS. | REMARKS |
|---|---|---|---|---|---|---|
| Low | A | 4045 Gr. | 45.0 | H | - | 3/16" cap |
| Medium | B | 1260 " | 13.8 | H | 1 | 3/16" " |
| Medium High | C | 120 " | 1.3 | " | 1-1/4 | " " |
| High | D | 560 " | 6.1 | " | 1-3/4 | " " |
| Extreme | E | 800 " | 8.9 | " | 2-1/2 | " " |
| Non Magnetic | F | 2260 " | 24.9 | " | | |
| TOTAL | | 8996 " | 100.0 | | | |

NOTE: The above results represent the percentages recovered respectively by machines of greater and greater strength as the sample was passed thru them successively. The non-magnetic is in the portion unaffected by magnetic treatment.
Adjustment Mag. Separator S Volts 2880 Amps 0 to 2-1/2 Speed 60' Cap 3/16 & 3/16"
440 R.P.M.

MANIPULATION AND OBSERVATIONS (By J.L.H.) Sample of natural abrasive - 80 mesh

ASSAYS AND RECOVERIES (ASSAYS BY)

| | PRODUCT No. | PRODUCT No. | PRODUCT No. | PRODUCT No. | PRODUCT No. | TOTAL EXTRACTION |
|---|---|---|---|---|---|---|
| Weight | | | | | | |
| % Total Wt. | | | | | | |
| ELEMENTS | ASSAY CONTENTS | ASSAY CONTENTS | ASSAY CONTENTS | ASSAY CONTENTS | ASSAY CONTENTS | |

MICROSCOPIC EXAMINATION (By J.L.H. ) Product - "AM" = Magnetite and Ilmenite. "C"=Red Garnet. "Dol"=Pale green and black garnet carrying some miscellaneous minerals. "F"= Silica sand.

CONCLUSIONS (By )

## Typical Analysis

*Garnet, magnetite, ilmenite, removed from the raw material — sample of daily work at the Magnetic Laboratory.*

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Deal camp somehow. From the President down, the effort is going to be to create a split between large business and small enterprise. The motive is obvious. The New Deal has not succeeded in stimulating large corporation activities for reemployment. Politically it is necessary to put the blame for this on the big companies. The small companies must not be alienated in the process.

A recognition of the effort to distinguish between two classes of business enterprise, on the basis of size only, explains much of the peculiar maneuvering of Washington. More effort like this is to be expected for the next sixteen months, until election day.

## Wanted: $1,000,000,000

TO BUY all of the strategic materials, mineral and non-material, which might be included under the stockpile purchases act would require well over a billion dollars. Perhaps one-third of this total represents mineral commodities which might be purchased. The major non-mineral item is rubber. The big question, therefore, becomes—What will the government purchase first?

The great joy of mineral economists who have worked for twenty years in the interest of mineral stockpiles is somewhat reduced by the fact that the bill as finally enacted covers not only the minerals originally proposed but also many non-mineral commodities. Nevertheless, there remains considerable hope late in June that the purchasing program under this act will devote most of the expected $25,000,000 for the next fiscal year to such goods as tin, quicksilver, sheet mica, chromium, tungsten, antimony, and graphite.

The first three of these unquestionably rate a high position in the mineral-purchasing program. Not only does the Government not have any natural resources to which to turn in time of war, but, also, commercial stocks are low, representing at most a very few months of peace-time consumption. The other four mineral commodities in this list are almost equally important so far as the Government need is concerned, but commercial stocks are enough greater to make immediate purchases perhaps a bit less urgent. In fact, with respect to graphite there is some doubt whether any purchases need be considered, as this item has been demoted from the strategic list to the critical list. Some argue, however, that this was not a warranted change.

All of these mineral commodities will be in competition with each other for some of the $25,000,000 likely to be appropriated soon, perhaps even before this item appears in print.

## Two Monopoly Metals

THE reasoning of those responsible for purchase of strategic metals and minerals is not published, but it is fair to assume that the reasoning of officials must be something like this with respect to two outstanding "monopoly" metals, aluminum and nickel:

The United States does not have either actively worked bauxite reserves or actively operating capacity for primary pig aluminum manufacture to serve full war-time needs of the United States. But the Aluminum Company of America does carry large reserve stocks of metal. Some believe these to be as much as eighteen months' peace-time supply, perhaps equivalent to a year's supply under military emergency. This gives peculiar "strategic" significance to aluminum. The United States probably could assist Alcoa and other firms to get enough bauxite. The original production capacity for primary pig could be expanded in case of need, probably to meet peak military requirements even without depending on Aluminum, Ltd. The United States could commandeer present stocks of pig aluminum in order to tide over emergency periods during this expansion and development. Such reasoning leads to the conclusion that although aluminum is on the strategic materials list, there need be no purchases by Uncle Sam.

The nickel reasoning is somewhat similar, but it involves International Nickel Company, a Canadian enterprise, in which the British Government is indirectly a large owner. The only thing to fear about nickel is, therefore, that profit-minded British owners might raise the price of this essential war-time material, perhaps even to the point of making it more costly to buy in time of emergency than it would have been to stock the metal in time of peace.

This philosophy might lead to the conclusion that Uncle Sam ought to buy and put away in his warehouses large quantities of crude nickel or its major alloys. But there are so many other commodities more urgently needed for which actual war-time deliveries would be difficult, regardless of price, that nickel is not likely to be one of the commodities bought soon. It is defined as "strategic." But its ownership is friendly, and its source near by. No purchasing is expected.

## The Manganese Problem

IT APPEARS that even the President is annoyed with the effort of certain groups to make stockpile building serve local political purposes. At one stage during the legislative efforts to pass the stockpile bill it seemed as though the bill might actually be defeated on the ground that Western mining interests were trying to dip into the Treasury too casually.

Seemingly this worries those who have to decide whether manganese will be one of the first commodities put into a stockpile. Actually, there is much less need for manganese buying than most people have claimed, because commercial stocks are substantial. Attempts to purchase are likely to be slow and difficult of completion. Two "outs" from this difficulty have been proposed. No one knows which (or whether either) will be used:

1. The President has the authority over the three Secretaries who fix policy as their executive boss. He has also additional authority over the Secretaries of War and Navy because he is Commander in Chief of both Army and Navy. In either capacity he may order the three Cabinet members from War, Navy, and Interior "to determine the quality and quantities of such materials which shall be purchased within the amount of the appropriations" in accordance with his idea of policy. In the last analysis the President's policy will be carried out if he chooses to press it.

2. The purchases of these materials must be made in the general public interest, "to prevent a dangerous and costly dependence of the United States upon foreign supplies in times of national emergency." The Treasury Procurement Division must then buy such goods at the best available price under world competition.

## News "Fines"

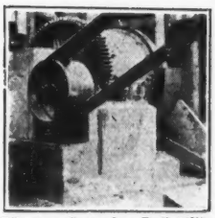
**Filing Labor Contracts** — Employers wishing to claim exemption from 44-hour week limits on the basis of special labor contracts must file these with the Wage-Hour Division. But only such contracts as provide workers shall not be employed more than 1,000 hours within a six-month period or 2,000 hours in a year are eligible to give employees permission to work up to 12 hours a day and 56 hours a week without special overtime compensation. Other labor contracts need not be filed by mine employers.

**Assessment Work**—Very unexpectedly at the end of June both houses of Congress approved the bill to extend the time during which claimants might do the annual assessment work normally required by June 30. The House proposed a 90-day extension, but the Senate cut this to 60 days, with House concurrence. The President was expected to sign the bill as soon as it reached him the first week of July.

**Copper Levy** — Along with nuisance taxes and other Federal tax measures which expired June 30 there was extended by a last-minute law the tax on imported copper. This equivalent to a tariff continues on the same basis as heretofore, as do the charges on coal and petroleum.

**Time for Safety**—Wage-Hour officials are anxious not to interfere with good safety practices and first-aid training. Soon after the promulgation of Interpretative Bulletin No. 13, that possible unfortunate consequence became evident. Revision was promptly promised; and much time was spent in June in working out a scheme to prevent Wage-Hour regulations from unduly burdening safety-first training. The interpretation of June 16 will permit strictly voluntary participation in most first-aid and safety work by employees without putting this in the "hours worked" class of activity.

**Labor Act Changes**—The most urgently pressed changes in NLRB policy were conceded by administrative action of the Board late in June. This greatly reduced the pressure for elaborate legislation and makes it unlikely that any important further modifications will be ordered by Congress. However, A.F. of L. and industrial leaders both continue pressure and may get legislation next year if not this. Most advantageous to most employers among administrative changes is the provision that the Board will recognize demands of the employer for an election to determine the representative labor organization. Previously only appeals of labor groups were so recognized.



Rib-cone Screening Ball Mills $220 up: screening or screenless types.

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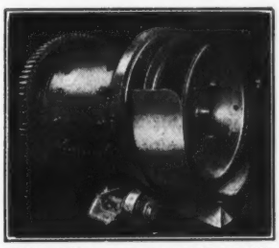
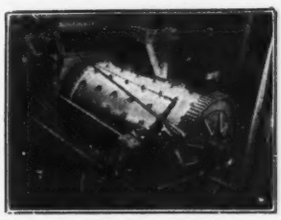


18-ton Rib-cone Screening Ball Mill, screen head type—does not require an external classifier.



Rake type Classifier with Rib-cone Ball Mills, 150 mesh product.

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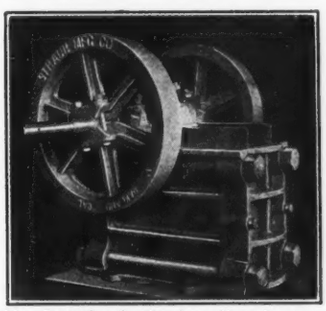

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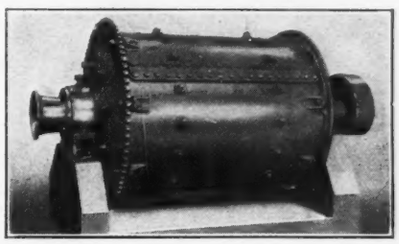

15-ton Rib-cone Regrind Mill, screenless type. Like all other screenless mills, it's all steel and manganese fitted.

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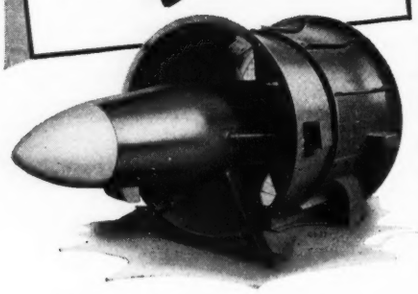

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# MONTANA

## Two Percent Mine Near Philipsburg Closed

**Low metal prices force suspension of operations — Further curtailment in copper production in prospect unless consumption of metal improves in near future**

▶ Because of low metal prices the Taylor Nelson & Knapp Company closed its operations on the Two Percent mine, in the Philipsburg district, early in June. Messrs. Taylor and Knapp have left for the East and will spend a part of the summer investigating gold properties in the southern Appalachians. Work at their Broadway mine, in the Silver Star district, under the direction of John Potts, of Salt Lake City, is reported to be progressing satisfactorily. In addition to operation of the cyanide plant, a considerable amount of direct shipping ores are produced.

▶ Since closing the Steward mine early in June, the Anaconda Copper Mining Company has announced no further reductions in copper production at Butte. During recent months stocks of refined copper have been increasing at an alarming rate, and it is hoped that this adjustment will be found adequate for the present. However, unless the consumption rate increases, the outlook for the immediate future is not encouraging, and additional curtailment may not be avoided.

▶ Representatives of the Montana mining industry have been active in making plans for the August meeting of the Mining Congress in Salt Lake City, Utah. It is expected that four of the 24 speakers to be selected will be from Montana. H. C. Bacorn, of Jardine, is chairman of the Montana division. The Montana committee includes: W. B. Daly, Alex Leggat, August Grunert, Carl Trauerman, and Dr. F. A. Thomson, of Butte; A. E. Wiggin, Great Falls; Lyman Brooks, Lewiston; Frank Blair, Virginia City; C. G. Crane, Whitehall; P. A. Wickham, Landusky; R. B. Caswell, Dillon; Gust Carlson and J. D. MacKenzie, Helena; and J. H. McLean Jr., Lewiston.

▶ It is reported that the Ralph Davis, Inc., operating a dragline plant in Silver Creek about 5 miles below Marysville, is handling about 5,000 cu.yds. of placer gravel a day. The plant, which consists of a stacker scow and a 4-yd. walking Monaghan dragline, has been in continuous operation since April 22. This is a Boise concern with other operations at Montour, Idaho, and should not be confused with the Ralph E. Davis Company, operating on Grasshopper Creek.

▶ Because of the uncertainty attached to the future silver purchase policy, J. D. MacKenzie issued a statement that purchases at the East Helena plant of the American Smelting & Refining Company would continue on the basis that has been in force during the winter up to and including June 23, 1939. Shipments received too late to permit delivery of affidavits to mints by June 30 would be settled on the basis of Handy and Harman silver quotations. Prices to be paid beyond this date will depend on what action is taken in Washington on the price for newly mined domestic silver.

▶ It is reported that Carl Martin, of Butte, is constructing a small cyanide plant to treat tailings from the old Drumlummin mine, at Marysville. The ores had formerly been amalgamated, and to permit efficient re-treatment will require a preliminary roast. A plant for this purpose is being planned in which natural gas will be used.

# NEVADA

## Cyanide Plant Being Built Near Lake Mead

**Lake Shore Gold Mining Company will soon start production from a 200-ton mill —Boulder Dam power may be extended to mining areas in Clarke County**

▶ Construction of a 200-ton cyanide mill is nearing completion on property of the Lake Shore Gold Mining Company in Gregg Basin, Clark County, five miles east of the north arm of Lake Mead, the body of water created by the construction of Boulder dam. Heretofore the company has shipped a substantial tonnage of high-grade gold ore to a Utah smelter, by truck to its pier on the lake, thence by barge and power boat to the rail point at Boulder City. The ore zone is a bedded deposit, 6 to 40 ft. thick, in coarse-grained, altered granite and is mined, after stripping shallow overburden, by means of a caterpillar bulldozer or carry-all. A water-supply line from Lake Mead has been completed. Fred D. Gibson heads the company, with offices at Las Vegas.

▶ Extension of a line to supply power from Boulder dam to Goodsprings and other districts in Clark County is provided for in reported plans of the Blue Diamond Corporation, Ltd., largest producer of gypsum in southern Nevada. The line is to be built to the gypsum plant near Arden and beyond to Sloan, Goodsprings, and to the 100-ton cyanide mill of the Chiquita Mining Company, Ltd. L. E. King is manager for the Blue Diamond Corporation.

▶ A cyanide mill, probably of 100 tons' capacity, is to be provided soon at the property of the Bruneau Gold Mining Company in the Rowland district, near the Idaho line in northern Elko County. Development is said to have opened a large mass of gold ore of good mill grade. R. R. Cook, of Rowland, is manager.

▶ Grading has been completed for a 50-ton cyanide mill on ground of the lately organized Adriatic Mines, Inc., which has acquired three old contiguous patented mines in Six Mile Canyon, just below Virginia City in the Comstock district. Howard Squires, Jr., is president and manager and Jess Midgley superintendent.

▶ Work has been resumed by the Owy-

hee River Copper Company on its claims near the Rio Tinto mine of the Mountain City Copper Company in northern Elko County. Outside of the copper area a quartz vein has been prospected that has yielded high assays in gold. J. H. Hooper, engineer and geologist, is manager at Rio Tinto.

▶ Dividend No. 7, at the rate of 3c. per share, was paid on June 20 by the Getchell Mine, Inc., bringing total disbursements within less than ten months to $375,000 on the 1,500,000 shares of no par value outstanding. An interest approximating 20 per cent is owned by the Newmont Mining Corporation. Additional washing tanks, now being installed, will shortly increase mill capacity from 850 to 1,000 tons per day, and a second and larger rotary furnace is to be provided for preliminary low-temperature roast of the sulphide ore, which contains much orpiment and realgar and the proportion of which increases, with relation to the surface oxidized ore, as the huge deposit is further opened on deeper levels through tunnels. Fred Wise, superintendent, receives mail at Redhouse, Nev.

▶ Work of repairing roads and reconditioning a 50-ton mill has been completed at property of the Silver Butte Mines Co., 12 miles north of Paradise Valley, Humboldt County. Gus Rogers, of Winnemucca, is in charge.

▶ A gold prospect in Secret Canyon, 10 miles south of Eureka, is being developed by the Eureka Corporation, Ltd., which has been operating and prospecting with diamond drills the Ruby Hill lead-silver area, west of Eureka. The corporation is composed of prominent Canadian operators for whom William Sharp, with headquarters at Eureka, is manager.

# COLORADO

## Rico Argentine Finds Some Copper Ore

**Vein is struck while driving a raise — Operations in most districts being maintained on a steady basis**

▶ The Rico-Argentine Company, at Rico, recently found copper ore in a vein, when driving a raise from the main level, up to the Log Cabin level. The mine, known as a silver, lead, and zinc producer, may force a change in the mill flowsheet if the copper ore develops into a sufficiently large volume. Ed. Bear is superintendent and Karl L. Erickson, mill superintendent.

▶ The development work carried on during the winter at the Chief Ouray Consolidated Company has progressed rapidly and smoothly under the direction of Lars Pilkaer, mine manager. The 5x7 ft. tunnel is in about 300 ft. where stringers of ore have been found. The objective is, a monzonite porphyry dike expected to be cut around 450 ft.

▶ The Durango district is active this season. Fred Olsen has taken a lease on the Mountain Quail property in


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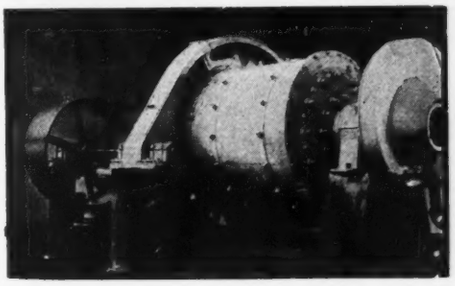

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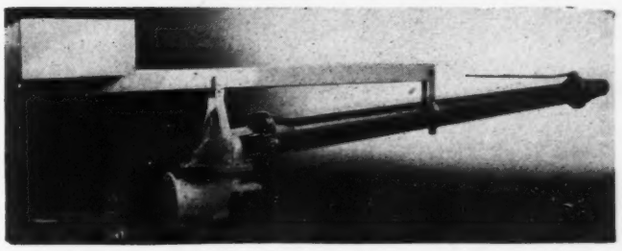

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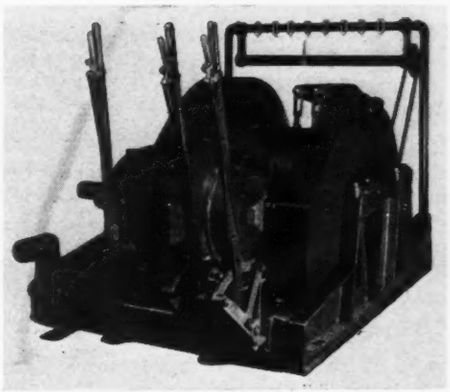

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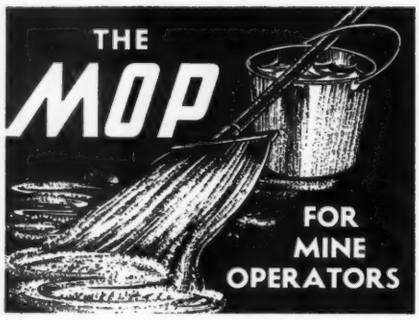


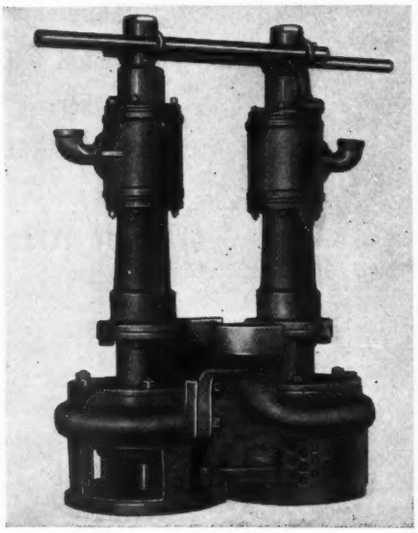

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## ▶COLORADO

Whitehead Gulch, south of Silverton. Axel Cedarwall has started development work on his claims near Hesperus. Jack Trompen, of Del Norte, is building a 25-ton diesel-powered mill to treat ores from his lode and placer claims. He states that 17,000 to 90,000 tons of milling ore are available. Ed Schnee is extending the drift from the main shaft on the Mary Ann and other claims. Phil Voight is developing his lode and placer claims on the Animas River. Murray Vosburg, Rush Sill, and Ross Finch have leased the Champion mine, San Juan County, from J. T. Hinkley, appointing H. G. Burgess mine superintendent.

▶ The Wolftongue Mining Company, under the direction of William Loach, continues to lead the production in tungsten near Boulder. The company's association with the Firth Sterling Steel Company, of Pennsylvania, assures steady disposal of tungsten.

▶ The Alice mine, in the Georgetown section, has been opened by the Porphyry Mines Inc., and president S. Thayer, of New York, states exploration and sampling are under way.

▶ William McCullough and Floyd Withrow, operating the American Nettie Mining Company at Ouray, are reported producing good ore. The gold ore occurs in vugs, as a replacement in quartzite about 20 ft. thick. Developments have exposed large bodies of lower-grade sulphide ore in the lower quartzite zone at its contact with limestone.

▶ The Pellevre Mining & Milling Company, under the direction of D. C. Gilbert, of Salt Lake City, is retimbering the Lexington tunnel southwest of Rico. Diamond drilling is also planned.

▶ George Shattinger, manager of the Pride of the West mine, at Silverton, is conducting a diamond drilling program.

# TRI-STATE

## Three Companies Suspend Milling Operations

**Plant of Baird Mining Company closed indefinitely — The Oklahoma Interstate Mining Company improves ore-handling facilities**

▶ Baird Mining Company's mill was closed down for an indefinite period early in June. The company is carrying on some underground development work during the shutdown, according to M. A. Baird, company manager.

▶ Kansas Explorations, Inc., have suspended operations at their Robinson mill, a mile northwest of Treece, Kan. The Lucky Seven Mining Company had been making a clean-up underground since early in the year, when the property was turned back to Kansas Explorations, Inc., by the American Zinc, Lead & Smelting Company, which had operated the property for several years. Ross Blake is district manager for the Kansas Explorations, Inc., a subsidiary of the St. Joseph Lead Company.

▶ Ritter Mining Company, Inc., has suspended operations on its mill on the old High Five lease in the Waco camp. Approximately twenty men will be affected by the shutdown, according to C. W. Ritter, manager of the company.

▶ Boulder Lead & Zinc Company has completed the dewatering of its mine on the Werts land, a mile north of Chitwood, Mo. Mining operations will be carried on the 110-ft. level. The F. E. Burton Mining Company will take over the mining operations and will truck the ore to the latter company's mill near Fillmore's bridge south of Joplin. Approximately twenty men are employed, according to F. E. Burton, company manager.

▶ Oklahoma-Interstate Mining Company has installed a surface unloading hopper of 100 tons' capacity at its Woodchuck mill, south of Cardin, Okla. The unloading hopper will be connected with the mill hopper by an incline tramway using 2½-ton tram cars. Ore from the Townsite mine, in Cardin, Okla., and the Cherokee mine, in Treece, Kan., will be trucked to the Woodchuck mill, according to C. F. Dike, company manager.

▶ Beck Mining Company has leased the 160-acre Dobson tract southwest of Hockerville and is subleasing the several shafts on the property, according to C. W. Nicolson, company manager.

# MICHIGAN

## Assessed Valuation of Mines Reduced

**Tax Commission adopts recommendations of State Appraiser of Mines for slightly lower basis in making determinations**

▶ The assessed valuations of three mining properties in Houghton County were reduced under the recommended valuations of the State Appraiser of Mines in the final determination of valuations by the State Tax Commission. The commission adopted the recommendations of the appraiser for assessed valuations in Keweenaw County. Champion and Globe of the Copper Range Company were reduced from a recommended $1,000,000 valuation to $900,000; Isle Royale was lowered from $125,000 to $100,000, and Quincy from $200,000 to $175,000. Final determination of valuations on other mining properties were as follows: Keweenaw County: Cliff, $12,500; Phoenix, $12,500; Central, $20,000; Ahmeek and Allouez, $1,150,000; Seneca, $200,000; Douglass, $30,000. Houghton County: Ahmeek mill and railway, $400,000; Centennial, $50,000; Conglomerate and shops, $475,000; Osceola, $100,000; North Kearsarge, $50,000; Reclamations, $3,295,000; LaSalle, $20,000; Superior, $10,000; Refined Copper, $517,482.

▶ Salvaged from the cargo of the steamer "Pewabic," which went down in

Lake Huron in 1865, a copper ingot donated by W. Parsons Todd, president of the Quincy Mining Company, will be placed on exhibition in the library of the Michigan College of Mining and Technology at Houghton. The gift was secured through the initiative of George Schubert, of Houghton, superintendent of the smelting department of the Copper Range company. Mr. Schubert is a former professor at the college. According to Mr. Schubert, the ingot was cast at the old Lake Superior smelter in Hancock in 1865. The "Pewabic" went down in about 160 ft. of water. The copper was recovered by the Leavitt, Armour Diving Company, of Toledo, Ohio, between 1913 and 1915. The Quincy Mining Company had about $40,000 worth of copper on the boat, partly insured. It was in the form of ingots and mass. Analysis of one of the ingots by Mr. Schubert shows that it contains copper plus silver 99.84 per cent; the silver content alone was 17.27 oz. per ton.

# IRON COUNTRY

## Ore Stocks at Lake Docks Slightly Reduced

**Shipments in May discourage operators—Only moderate pick-up expected in June—Staff of Oliver Iron Mining Company on 40-hour work-week basis**

▶ Lake Superior iron ore consumption in May was 2,245,513 tons, compared with 2,799,769 for the previous month, the Lake Superior Iron Ore Association reported. Consumption a year ago was 1,711,146 tons. Ore on hand at Lake docks and furnaces June 1 was 23,071,214 tons, compared to 22,790,933 a month ago and 33,011,974 a year ago. Furnaces in blast June 1 numbered 189, the same as the previous month, against 188 a year ago. The reduction of about a half million tons from the preceding month was discouraging to the iron-ore mining companies. June is expected to show an increase, but not sufficient to increase employment or open any new mines.

▶ The International Harvester Company has closed the Agnew underground mine at Hibbing, Minn., temporarily and is shipping from stockpile. The Canisteo mine, at Coleraine, Minn., started shipping on June 23 and expects to operate one shift five days a week until the end of the shipping season. The steel corporations are operating steadily at their various properties, but most of the independents are marking time.

▶ Pickands, Mather & Company have recently purchased a new Bucyrus-Erie 120-B electric shovel equipped with a 5-yard dipper for use at the Scranton mine, at Hibbing, Minn.

▶ Oliver Iron Mining Company's salaried men are now working on a 40-hour week basis, as are those of some of the other independent companies. No changes have been made in the rate of wages around the mines and nothing is heard concerning any movements in labor organizations.


# WOOD HULL DREDGES
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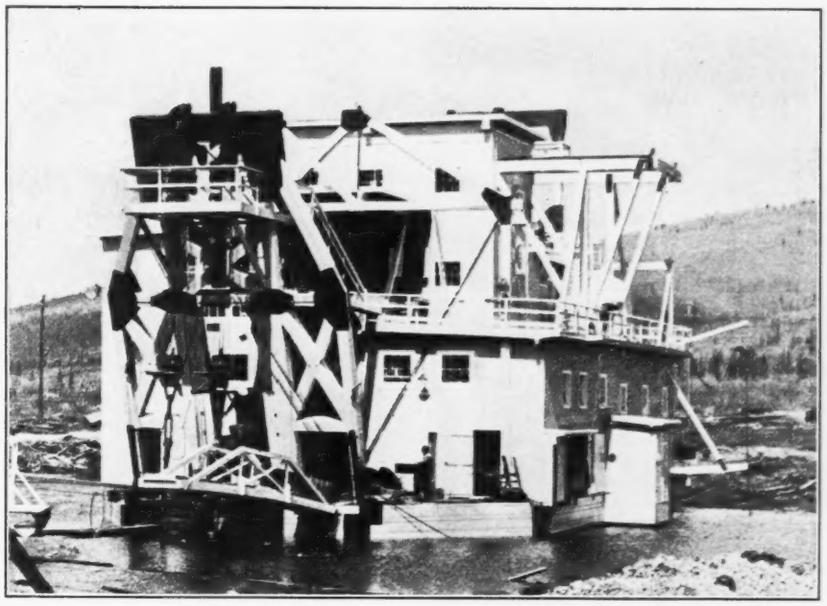

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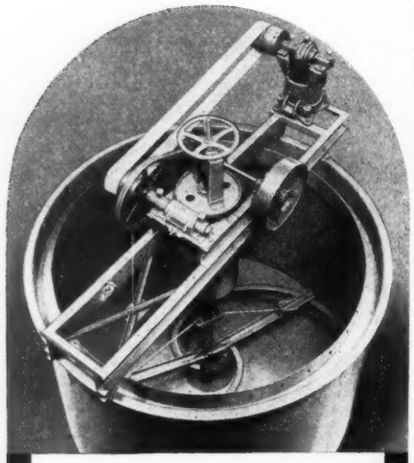

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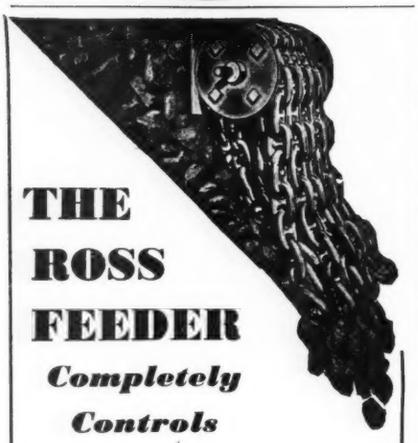

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*The King and Queen, wearing hard-boiled hats, descended to the 2,800 level of the Frood nickel mine, in Canada, on June 5, accompanied by D. MacAskill and R. Parker, general manager and general superintendent, respectively, and other staff members*

# CANADA

## Prospectors Active in Bear River Region, B. C.

**West Coast of Vancouver Island being examined following success of Zeballos area — Creighton mine will increase production, making up for loss at the Frood mine due to ground subsidence**

▶ In honor of the King and Queen's visit at Sudbury on June 5, a general holiday was declared throughout the mining districts of northern Quebec and Ontario. There were wildly cheering crowds all along the 12 miles of highway from Sudbury out to the Copper Cliff smelter, where Donald MacAskill, general manager, and other officials of International Nickel, led the royal party on a tour of inspection. The event was featured by a trip underground at the Frood mine. Both visitors put on miner's clothing and were taken to the 2,200 face on the 2,800-ft. level. It is reported that the Queen collected samples to take back home for her daughters.

### British Columbia

▶ Stimulated by the successful development of the Zeballos area in the past two years and by the discovery of two or three promising gold deposits elsewhere along the west coast of Vancouver Island, prospectors this year are engaged in an intensive search for gold-bearing veins in several favorable areas on the Island. Possibly the most active region is Bear River, where about 200 claims have been staked, extending from Bedwell Sound to fifteen miles up the river. The encouraging results being obtained by Pioneer Gold Mines and Anglo-Huronian, Ltd., on the Musketeer and Shamrock groups is the chief cause of the interest in this area.

▶ In the Zeballos region itself, 60 miles northwest of Herbert Arm, Privateer Mine, the largest operator, has started the underground exploration of two of the four new veins recently found on the surface. A 300-hp. Ruston diesel engine and other machinery have been ordered to increase the capacity of the power plant, and when this is installed an internal shaft will be sunk from the 1,100 level to open two more levels on the main vein. Production in May was valued at $101,970, 2,913 oz. of gold being recovered from 2,298 tons of ore.

▶ A fourth mill is to be built at Zeballos this summer. Mount Zeballos Gold Mines has purchased the 50-ton plant of Gold Mountain Mines at Hedley and it will be moved to the west coast at once. Conwest Exploration Company, of Toronto, which holds a 50 per cent interest, has loaned Mount Zeballos $100,000 to put the mine into production.

▶ Canty Gold Mines has announced its intention to build a 50-ton mill at its property near Hedley. V. J. Creeden, secretary, states that the management is satisfied there is sufficient ore to warrant a plant of this size. Until it has been put into operation, further exploration will be curtailed.

▶ Reno Gold Mines is preparing to resume operation of its 140-ton mill in October as a result of the favorable results obtained in developing the Motherlode vein at the 4,900 level, 600 ft. below the old No. 5 level. A 2,500 aerial tramline will be built from the portal of the new tunnel to the mill, and a new camp constructed. W. S. Ellis is superintendent.

▶ Another new area may be brought into production if the results of this season's operations on the Homathko River are favorable. At the Taylor-Windfall mine it is reported that the oreshoot at the 300 level has been opened for a distance of 110 ft., and last year at the 200 level ore averaging 1 oz. gold across a width of from 12 to 18 in. was developed for a length of 300 ft. Encouraging results have also been obtained at the Homathko mine by the Timmins Corporation.

▶ Milling at the Big Missouri mine, near Stewart, was resumed on May 25 after an interruption of several weeks due to a shortage of water power. The operating company, Buena Vista Mining Company, reports a gross profit of $76,310 for the six months ended March 31, and most of this went towards reducing the company's heavy indebtedness to the holding companies, Consolidated Mining & Smelting Company and Big Missouri Mines Corporation. G. H. Rainville, president of the latter company, states that to earn larger profits it would be necessary to increase the milling rate, now 750 tons a day, and this would depend upon the development of more ore.

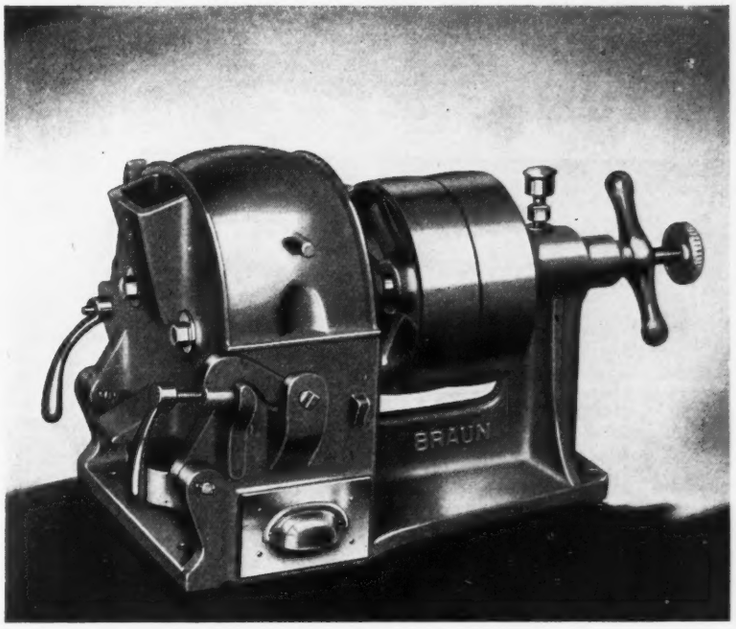
### Ontario

▶ Ground subsidence between the 2,000- and 2,600-ft. levels of the Frood mine, of the International Nickel Company of Canada, occurred around 3 o'clock on the morning of June 30. Engineers of the company had been anticipating settlement in this section two days prior to the movement, and all men were, therefore, withdrawn in ample time. Dr. John F. Thompson, executive vice-president of the company, issued the following statement on June 30: "There was some movement in the section of the Frood mine yesterday between the 2,000- and 2,600-ft. levels. There was plenty of warning and men were all withdrawn in advance. This movement affects only a small part of the mine. When this movement has come to rest a thorough examination will be made before the men are sent in again and mining is resumed. Any reduction in tonnage due to this movement will be made up through other parts of the Frood and from other operations."

▶ R. D. Caylor, manager of Minto Gold Mines, in the Michipicoten district, reports the location of what appears to be the apex of a new orebody on the fifth or bottom level of the Jubilee mine. Salvage of marginal ore from upper horizons largely covers development cost with the mill treating 80 tons daily of this ore. In 1938 the mill treated 7,851 tons for an average recovery of $9.65; working costs were $5.87 a ton, including ore salvaged from a small orebody at the Cooper mine.

### Quebec

▶ Working costs at Francoeur Gold Mines are expected to be reduced as soon as the new 200-ton cyanide mill, started early in June, begins operating. The future outlook of the mine is further strengthened by the discovery of new ore both on surface and underground, as well as the expansion of ore reserves in developed sections. The addition of cyanide treatment will eliminate the trucking of concentrates to No-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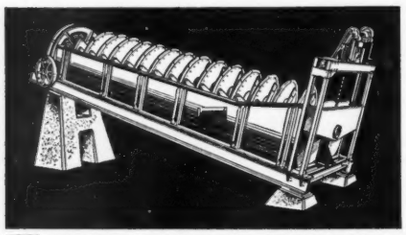

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## ▶CANADA

randa, but will involve no important changes in the flowsheet. Flotation concentrates will be reduced from about $125 to $50 a ton, the concentrates dropping from the filter into a new ball mill for secondary grinding.

▶Working costs below $2 a ton are expected at the Aldermac mine after the new bottom level is developed. Ore reserves have been built up to provide mill feed for about four years. Production is being maintained at 1,000 tons daily, the copper concentrates being shipped to a smelter at Carteret, N. J. It has not been possible so far to find markets for pyrite concentrates, which has held up the installation of machinery in the large building, completed last winter, for the recovery of elemental sulphur.

▶The Eustis mine of the Consolidated Copper & Sulphur Company is being closed down due to ore exhaustion. In recent years F. W. Snow has been mine manager, taking the credit for deepening the inclined shaft, started during the copper boom of Civil War days, below 7,500 ft., and overcoming many problems to maintain production. The mine has been in continuous operation for more than 70 years.

# MEXICO

## Government to Provide Smelters for Small Miners

**Independence from foreign units sought as plans go forward to erect plants in four mineral districts — Gold output from Marguarichic and Junta de Piedras mines, in Chihuahua, expected to decline in future**

▶Mexican mining had some interesting developments with the advent of summer. Anxiety was noted because of the silver situation and decreased buying of the Mexican metal by the United States during the past couple of months. Yet all was not pessimism in this regard. The opinion is that the American market will continue to purchase a fair amount of Mexican silver for the sake of trade balances. The government apparently intends to incorporate more abandoned mining tracts into the federal mineral reserves or give them to prospectors and other small-scale miners to work on a cooperative basis. But expropriation, at least on a large scale, in the mining industry, is considered to be, at present, out of the question. The oil affair is still a very weighty problem for the government, and no sign of its solution is yet in sight. The government continues to be enthusiastic for the cooperative running of mining properties. It is helping along existing societies and has organized one to work two important gold properties in Sonora. A high government official made presents of material and cash to this society.

▶A miners' cooperative society is being organized by the national commission for stimulation of the mining industry to take over and work the La Colorado and Las Prietas mines, near Hermosillo, Sonora, good gold producers until activities in them ceased several years ago. The society, which is expected to start work during July, has been helped by Ing. Efrain Buenrostro, Minister of National Economy, with gifts of pumps, 8,000 meters of pipe for drinking water, and 1,000 pesos ($200) in cash to repair buildings.

▶The national commission for stimulation of the mining industry has been ordered by President Lazaro Cardenas to provide a metal-treatment plant for prospectors and other small operators in each of the four principal mineral zones of Mexico, for the explained purpose of making these workers independent of the plants of foreign mining companies.

▶A 100-ton daily capacity mill is to be built at Mineral de El Cedro, Guanajuato, for prospectors and small workers by the Mexican Government. It will service the Pinguico, Nayal, Cardones, Santo Niño, La Union, El Carmen, and Cabrestante districts. The mill is to start work in September.

▶Claims totaling 2,654,216.14 pesos ($530,800) for lost wages and participation in profits have been filed with the Federal Board of Conciliation and Arbitration against Mazapil Copper, Concepcion del Oro, Zacatecas, by 683 miners, who say they were dismissed when the company suspended work Sept. 10, 1930, but were not reinstated, as they allege the firm promised, when operations were resumed Aug. 1, 1934. The claims cover wages and profit sharing for five years. The company was denied federal permission to suspend operation temporarily because of financial loss.

▶President Lazaro Cardenas has ordered the Federal Government to match the monthly contribution of 2,000 pesos ($400) of the Sonora administration for the relief of miners of the Cananea district who suffer from silicosis. The Federal Government is also to establish as farmers on public lands as many of these miners as possible.

▶The Mexican health and labor departments have called for September in Pachuca, Hidalgo, the first national convention on silicosis. Mining companies and miners' unions' doctors and representatives of official and private institutions concerned with silicosis will meet and discuss problems and practice.

▶Increased operations are being prepared by National Gold-Silver, J. D. Raines, president, at Taviche, Oaxaca, so that production may commence in August. Satisfactory arrangements have been made with the workers. Ed Harris is directing operation. A. R. Burnett is directing construction.

▶Elimination of trouble arising from prospectors' poaching on its property is promised for the Neg. Minera Santa Rosa y Anexas, S.A., Santa Rosa and Mazapil, Zacatecas, by Lic. Guillermo Vallejo Leal, legal representative, who has made a pact with the national miners' union. The pact, approved by the federal labor department, provides that the

company employ for certain periods 85 prospectors, eight of whom will be foremen for the others. Before these men can be employed, they must undergo a medical examination to prove that they are fit for work. The company agreed to compensate all such men it employs with 90 days pay in cases when it must dismiss them before the expiration of work contracts. These prospectors are entitled to work for other companies. This is the first agreement of the kind to be made in Mexican mining.

▶ Geologists have advised the state government of Chihuahua that unless development of veins of the Marguarichic and Junta de Piedras districts improve within the next three months future operations there face curtailment in gold production.

▶ Penhoel-Menardi Engineering Company, Ltd., mining and metallurgical engineers, Los Angeles, Calif., have contracted to equip the Huahuaxtla mine, in Estado de Guerrero, Mexico, with a quicksilver plant. The mine is being operated by Alfredo Terrazas, who has purchased a 100-ton Nichols Herreshoff furnace manufactured by Pacific Foundry Company, Ltd., San Francisco.

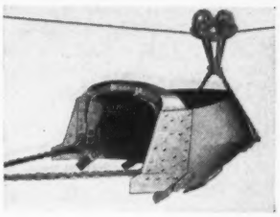
▶ Mining firms are included in stricter enforcement of the federal law which demands that all companies must have at least 90 per cent of their employees Mexicans.

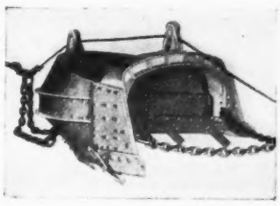
# AFRICA

## Good Drilling Results In Orange Free State

**Preliminary reports of two additional drill holes encourage belief large area will produce gold mines in the future — Rhodesian Broken Hill Development Company to test recovery of vanadium by flotation**

▶ Drilling results are giving further encouragement to those who believe important gold mines will be developed on an extension of the Witwatersrand reefs in the Orange Free State, at the great distance of 150 miles southwest from Johannesburg. It is also evident from drilling disclosures that most of the area between these distant points will be occupied by gold mines yet to be developed. The importance of the drills having found encouraging values in gold —in most cases payable values—is supplemented by their having proved that the strata are continuous, no indication of their having been broken up and displaced, as might have been feared, being as yet disclosed. Western Holdings, which is carrying on an extensive drilling campaign in the Orange Free State, recently reported the preliminary results of two additional boreholes, Prairie No. 3 which cut 86.5 in. of conglomerate at a depth of 3,088 ft., assaying only 2 dwt., and Vlakplaats No. 2, which cut 11.5 in. of reef assaying 16.5 dwt. per ton. The depth in the latter is 1,307 ft. It is calculated that Western Holdings has now roughly proved





Illustrated are three sizes of Crescent buckets including one with carrier for slacklime duty. The complete line comprise sizes from ¼ to 15 cu. yd.

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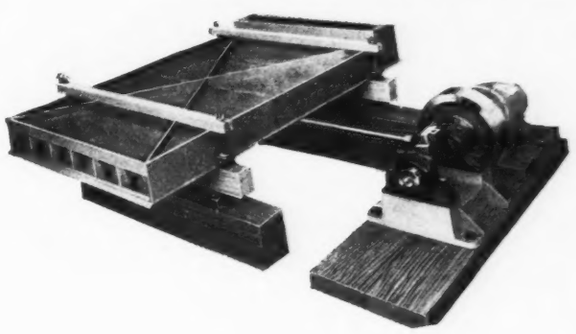

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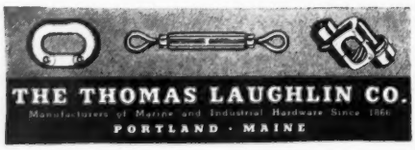

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## ▶AFRICA

the existence of gold-bearing conglomerate over a continuous distance of 2¾ miles. Prairie No. 3, however, is about 10,000 ft. farther south than any other completed borehole, and the results of drilling the intervening gap of nearly two miles are awaited now it is known that the Witwatersrand strata continue in that direction.

▶Time for the Witwatersrand gold-mining companies to declare dividends from profits of the six months to June 30 is now at hand. A few have already taken such action. A small producer, East Champ d'Or, is the only one so far to announce an increase. It is from 6d. a year ago and 9d. six months ago to 10½d. at present. Government Areas, Langlaagte, and Van Ryn Deep are paying a shade less, and New State Areas, Randfontein, and Witwatersrand Gold the same as for the closing half of last year.

▶East Geduld Mines earned a final net profit for the past year of £1,158,870, after taxation and all other deductions, which is £186,066 more than a year ago. Dividends paid the past year amounted to 57½ per cent. Its ore reserves, recalculated at the end of last year, are now 11,500,000 tons averaging 6 dwt. per ton over a stoping width of 58 in. Of the 20,360 ft. of development work done on reef the past year, 14,650 ft., or 72 per cent, revealed an average of 13.2 dwt. per ton over widths averaging 35 in.

▶S. S. Taylor, who has succeeded the late Sir Edmund Davis as chairman of Rhodesia Broken Hill Development Company, declared at the annual meeting that diamond drilling had disclosed a much larger tonnage of ore than expected. Oxidation has been found to extend to great depth, however, and a considerable proportion of the tonnage is oxide ore. A redeeming feature is that the oxide ore carries an average of 1 per cent vanadium oxide. The bulk of the greatly increased output of fused vanadium has been recovered from dumps on the surface, and these will before long be exhausted. In consequence, in computing the future probable earnings of the company, profits from vanadium had been disregarded, it being anticipated that the vanadium content of the ore would decrease or disappear at depth. It is now probable that vanadium production can be continued from mine ores. The possibility of recovering vanadium minerals by flotation is to be tested. A systematic research of differential flotation on Broken Hill ores has been carried out by the American Cyanamid Company, and has provided valuable information which will be used as a guide in planning a pilot plant. It already has been decided that the Mulungushi hydro-electric plant will not supply sufficient power for future requirements, even though water is now running over the top of the dam, and the installation of a hydro-electric plant on the Lunsemfwa River is being considered.

▶Returns so far received indicate that over one-third of the Witwatersrand gold producing companies made new high records of profits in May. The total production in ounces of gold was 1,083,843, a new high record.

▶The Saudi Arabian Mining Syndicate has completed its mill of 300 tons' daily capacity, and milling started the first day of June.

# AUSTRALIA

## New Dredges Will Add To Gold and Tin Output

**Construction of one of world's largest gold-recovery units now under way for use in Victoria—Broken Hill lead-zinc mine being explored in depth by diamond drilling**

### Western Australia

▶Mount Magnet Gold Mines, Ltd., an English company operating at Mount Magnet, treated 59,671 tons during 1938 for 7,639 oz., equivalent to 2.56 dwt. per ton, a low-grade record for the State. At the Hill 50 mine, in the same district, a new lens of ore (No. 5) is being developed on the 200-ft. level, a width of up to 25 ft., length of 100 ft. and height of 50 ft. having been proved to date. Assays are from 6 to 8 dwt. per ton.

▶Blue Spec Mines, N. L., has been formed by Consolidated Gold Areas, N. L., to test the Blue Spec gold-antimony mine at Nullagine, at present under option to the latter company. Tests at the Adelaide School of Mines indicate that the ore is amenable to flotation treatment.

▶Greenbushes Tin, Ltd., is installing a bucket dredge, of 80,000-cu.yd. monthly capacity, at Greenbushes. The pontoon, which is 100 ft. long and 15 ft. wide, was launched in May. This will be the first bucket dredge of any size to be operated in Western Australia. E. Sutherland Browne is manager.

▶Diamond drilling recently commenced by Gold Mines of Kalgoorlie, Ltd., in the central part of the field and north of the Golden Mile, may have results that will have an important influence on the future of Kalgoorlie if the objectives, the lode channels at present being worked in the Croesus Proprietary Mine (at the extreme north end of the Golden Mile), are located. Prominence has recently been given to a report by Dr. C. O. G. Larcombe, who considers that the work at the Hannan's North Mine (to the north of the area at present being drilled) where the ore deposits have been proved to exist continuously down to at least 1000 ft., gives distinct promise for the future of the north end of the field.

▶Ore reserves of Boulder Perseverance, Ltd., Kalgoorlie, have been published for the first time; in the past only ore broken has been given. The total, 400,900 tons, of which 97,000 tons is probable ore, is a little less than four years' mill supply. Average grade is 7.2 dwt. per ton, compared with last year's head value of 7.75 dwt.

### Victoria

▶ Details of the new dredge for Harrietville (Tronoh), Ltd., which is to operate on an area containing 95,000,000 cu.yd., averaging 1.9 grains per cubic yard, near Harrietville, Vic., show that it will be one of the largest in the world. Equipped with 20-cu.ft. manganese steel buckets, the dredge is to be capable of digging 350,000 cu.yd. monthly from a depth of 130 ft. below water level; a high bank will be carried in front of the dredge to increase the effective digging depth, which may be as much as 160 ft. Gold collection will be by jigs. Electric power will be used. Construction has commenced.

▶ The dredge of Redbank Dredging, N. L., Redbank, has recommended operations after completion of repairs to the power plant. Some difficulty is being experienced in securing full bucket capacity owing to the clay overburden. Modifications to overcome the trouble are in hand.

▶ Adelong Gold Estates, N. L., which is operating a small steam-driven dredge near Bright, has shut down the plant for repairs and reconditioning estimated to require eight to ten weeks and to cost £3,000 Aust.

### New South Wales

▶ Wellington Alluvials, Ltd., treated 2,710,000 cu.yd. in its dredge on the Macquarie River during the year to April 30, which was the first full year of operation. Recovery is estimated at 12,284 oz., an average of 2.2 grains per cubic yard.

▶ Although stoping has ceased at the Broken Hill lead-zinc mine of the Broken Hill Proprietary Company Ltd., diamond-drilling operations are in progress to locate a repetition of the main lode systems below the present workings. It is reported that drilling will extend to a depth of 3,000 ft.

### Queensland

▶ Mount Morgan, Ltd., is now approaching its scheduled rate of copper production, the yield last four-weekly period being 241 tons or at the rate of 3,130 tons annually. A shipment of concentrates of about 2,500 tons, the last produced before the erection of the company's own smelters, is to go to Tacoma, U. S. A., for treatment in July.

### Tasmania

▶ Endurance Tin Mining Company, N. L., operating a hydraulic sluicing property at South Mount Cameron, reports reserves of 2,000,000 cu.yd. of ground averaging 0.7 lb. tin oxide per cubic yard. Treatment is at the rate of 15,000 cu.yd. weekly.

▶ Montana Silver Lead, N. L., which is developing a property at Zeehan, carried out a considerable quantity of development work during the year to Feb. 28, and hopes to be able to install a small treatment plant during the coming year. A flotation unit of 1,500 tons' monthly capacity, to cost £10,000, is under consideration.

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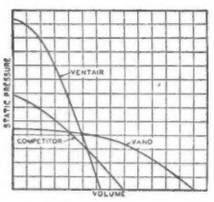


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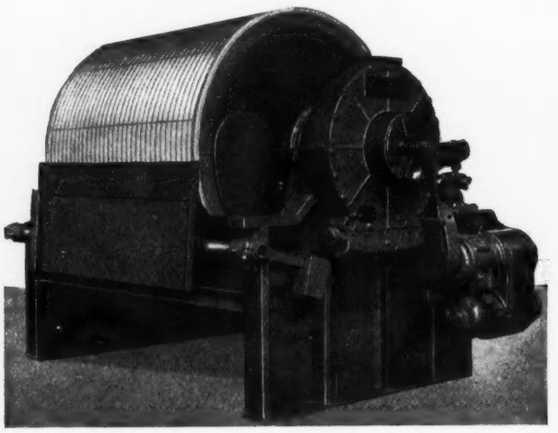

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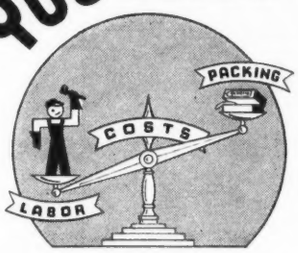


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# NEW BOOKS

PRINCIPLES OF FLOTATION. *By Ian W. Wark, Australasian Institute of Mining and Metallurgy. Tait Book Company, 349 Collins St., Melbourne, Australia. Pp. 346. Price 21s. in Australia.*

THIS VOLUME is a monograph which should prove of invaluable interest to the increasing number of investigators interested in flotation research. Dr. Wark presents a scholarly summary of the work which, for some years, has been conducted in his laboratories at the University of Melbourne, together with contributions and views of other workers in the field. In cases that are still the subject of controversy, he gives his opinions derived from a careful consideration of experimental work carried out in his and other laboratories.

The book was never intended to be a textbook of flotation nor a comprehensive treatise on the subject; nor, for that matter, is it to be considered a manual. "Principles of Flotation" is primarily a reference book to be kept within easy reach by the man in the flotation laboratory and by the man who speculates on likely theories and hypotheses as explanation of flotation phenomena. It comprises thirteen chapters: Chapter one, a general introduction, includes a brief summary of the historical background of flotation, together with a presentation of the theories proposed to explain frothing, collection, and conditioning. Chapter two deals with the so-called "Variables of Flotation," including a discussion of the character of ores, pulp density, and mill waters. Chapter three is directed to the physical principles involved in flotation. Wetting, adsorption, and the various types of processes used are discussed. Chapter four briefly discusses experimental methods used in flotation investigations.

The next chapter deals with the classification of flotation reagents, covering the various types of collectors, frothers, activators, and depressors. Chapter six discusses the experimental results and the theories on the use of xanthates as collectors for sulphide minerals. Chapter seven is similar in scope, but the collectors discussed are those not of the xanthate type, such as the soaps and the amines.

Chapters eight and nine deal with activation reagents and depressants respectively. Dr. Wark discusses the effect of well-known activating agents for certain minerals in connection with specific collectors. He also discusses depressants in connection with specific minerals and collectors. Chapter nine also discusses the joint effect of copper sulphate and sodium cyanide on the flotation of sulphide minerals with xanthates.

Chapter ten deals with the collectors for non-sulphide minerals, comprising a discussion on the controversial subject of the "inherent floatability" of sulphur and graphite, a subject primarily of theoretical importance in that it supplies a field of experimentation for the adherents and proponents of the chemical theory, as well as the adsorption theory, of flotation.

The eleventh chapter has to do with frothing and chapter twelve with the influence of colloids in flotation. The latter also discusses slime-coatings, as well as flocculation and dispersion of mineral particles as indices of floatability or non-floatability of minerals. The concluding chapter thirteen deals with a relatively little known subject in flotation—namely, the electrical properties of surfaces in relation to flotation.

The book includes a bibliography of recent literature on flotation, which, although not comprehensive, is of distinct help in that it lists the source material necessary for obtaining a knowledge of the present status of flotation investigation. The monograph is highly recommended to the research worker.

G. R. M. DEL GIUDICE

DESCRIPTIVE LIST OF THE NEW MINERALS, 1892–1938. *Compiled by George Letchworth English. McGraw-Hill Book Company, New York and London. Pp. 258. Price $3.*

REALIZING the arduous labor involved in hunting through much literature to find descriptions of new minerals, the compiler has produced an alphabetical list that should save a vast amount of time for mineralogists. The data for each mineral are compiled from standard sources, and include crystal system, form, color, hardness, specific gravity, chemical composition, chemical formula, prominent localities, and literature references. The expert competence of the compiler is adequate assurance of the reliability and authority of the work.

PHILIPPINE MINING YEARBOOK 1939. *Official publication of the Chamber of Mines of the Philippines. Ralph Keeler, editor and publisher. Manila, P. I. Vol. 1. No. 1. Pp. 244. Price $1.00.*

INTEREST in Philippine gold mining is increasing with each year's announcement of greater gold production from the Islands. Mining is second to the sugar industry in value of exports and many observers believe Philippine mining has only begun. This yearbook produces evidence of the great advances that have been made not only in gold mining but the production of other metals as well. Sponsored by the Chamber of Mines of the Philippines and published by Ralph Keeler, well known in the Philippine mining industry, the yearbook gives a thorough description of the various mining districts, mining enterprises and value of their respective gold production. Financial reports of companies are also included. Early mining history as well as present methods of mining and milling of many of the companies are described. The book is well illustrated and is recommended for those interested in having a ready source of information on virtually everything connected with gold mining in the Philippines.

GEM AND GEM MATERIALS. *By E. H. Kraus and C. B. Slawson. McGraw-Hill Book Company, Inc., New York and London. Pp. 287. Price $3.50.*

THE 1939 edition of this book has undergone a thorough revision from the printings in 1925 and 1931 respectively. Sixty-five new illustrations, twenty-seven pages, and a chapter on metals used in gem settings have been added, together with four attractive color plates. Divided into three parts, Part 1 describes the various properties of gems, crystal formations, cutting, polishing and their naming. A chapter on manufactured gems supplies interesting reading and information on treated, synthetic, and imitation gems. Part 2 is a description of individual gems, and Part 3 contains a classification of gem materials according to various physical properties. The book closes with a descriptive summary of gem materials arranged alphabetically. This new edition covers the subject fully and should satisfy that desire held by many persons seeking to learn about diamonds, sapphires, rubies, and many other commercial gems.

▼

## PUBLICATIONS

### RECEIVED

*Index to A.S.T.M. Standards and Tentative Standards* (including list of A.S.T.M. serial designations). Jan. 1939. American Society for Testing Materials, 260 S. Broad St., Philadelphia. Pp. 129.

*Uganda.* Bulletin No. 3 of the Geological Survey at Entebbe. Papers relating to the geology of Uganda, including one on the tantalite-columbite deposits in the southwest. Also biography and provisional geological map. Pp. 196. Price 10s 6d.

*Diesel Engines, Theory and Design.* By H. E. Degler. Published by the American Technical Society, Drexel Ave. and 58th St., Chicago. Pp. 270. Price $2.50.

*French West Africa.* Bulletin No. 2 of the Service des Mines; post office address, Dakar. Pp. 69 and maps.

*Geology of Vermont.* Report of State Geologist on 1937-38. By Elbridge C. Jacobs, State Geologist, Burlington, Vt. Pp. 101.

*Non-metallic Minerals (Miscellaneous) in Canada, 1937.* Dominion Bureau of Statistics, Ottawa. Pp. 25. Price 15c.

*Idaho Mining Industry, 1938.* Annual report of Arthur Campbell, Inspector of Mines, Boise, Idaho. Pp. 275.

*L'Industrie Minerale de l'Indochine en 1937.* By R. Guillaumat, chief of the Service des Mines, Hanoi, French Indo-China. Pp. 100.

*Mount Weather Testing Adit. Progress Report No. 1.* By McHenry Mosier and Wing G. Agnew. Report of Investigations 3439. U. S. Bureau of Mines, Washington, D. C.

*British Guiana Geological Survey.* Bulletin 12, reporting on four gold areas. Price, 24c. local currency. Georgetown, Demerara. Pp. 49.

*Crushed Stone Industry.* A study. Works Progress Administration National Research Project and U. S. Bureau of Mines. Pp. 169.

*Canada Mineral Production, 1938.* Preliminary Report. Dominion Bureau of Statistics, Ottawa. Pp. 44. Price 25c.

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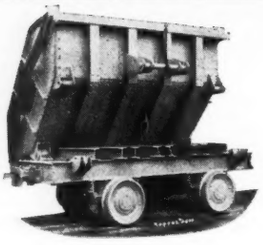

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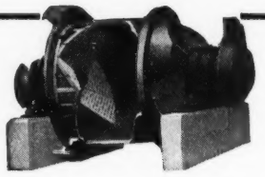

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# EQUIPMENT NEWS

**Refraction Type Seismic Prospecting Apparatus**

THE GEOPHYSICAL INSTRUMENT Company, Washington, D. C., announces a light-weight portable refraction seismic apparatus intended to discover conditions underground by refraction seismic technique. The manufacturer's theory of the operation is as follows: A charge of explosive is buried in the ground and fired. The seismic waves created by the explosion are detected at some distance from the charge by means of sensitive detectors. The instant of arrival of the seismic wave at each detector is recorded automatically on a moving film. By comparing the time of travel of the sound to detectors placed at different distances, inferences can be drawn regarding the character of the material beneath the surface. This information is said to often prove sufficient to tell whether or not the presence of oil or of certain minerals is likely. In other cases it will indicate depth to bedrock and the type of material underground. The oscillograph unit, shown on the camp chair, in above cut, contains the galvanometer elements for recording impulses from the detectors. It also houses lamps, controls, meters and batteries necessary for operation. Firing the charges is done by means of either a manual control on the panel, or by an automatic switch mounted within the camera. The camera unit is attached on the right side of the oscillograph. Current for shot firing is supplied by a battery within the unit.

An optical system independent of that used for the galvanometers throws the image of slits on the films. Time lines are marked every 0.005 second, allowing easy estimation to within 0.001 second. One man can operate the entire apparatus, but the manufacturers advise a crew of at least three men should be used to simplify operation.

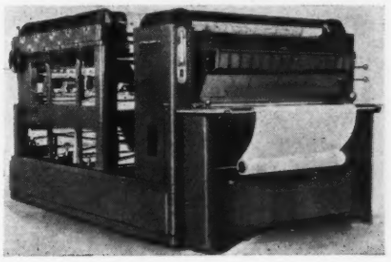
## New Electric Blasting Cap

A NEW ELECTRIC blasting cap and a delay electric blasting cap sealed with rubber and equipped with plastic insulated wires are announced by E. I. du Pont de Nemours & Company, Wilmington, Del. The plastic insulation comprises a plasticized ethyl cellulose composition. This is the first time an electrical insulation of plastic extruded on wire has ever been marketed in this country. The improved insulation overcomes the difficulty sometimes experienced with the old cotton insulated nonenameled wires when leakage was so great that the current reaching the caps was not sufficient to detonate them. Abrasion resistance of the plastic is greater than that of the cotton insulation, reducing the danger of short circuits which might cause failure of the caps to detonate.

Instantaneous caps will be equipped with two red wires and the delay caps with one red and one yellow wire, making the wires easier to see, particularly in underground work. The new closure consists of a 7/16-in. rubber plug crimped into the copper cap shell. Rubber has been found to make a much more effective seal than the combination of sulphur and asphalt previously used. As a result, the new rubber plug, replacing the former plug of sulphur and asphalt, is said to make the caps more resistant to water than the special waterproof caps now on the market. Manufacture of the old special waterproofed caps will eventually be discontinued. The rubber plug will be used on all electric blasting caps and delay electric blasting caps. The instantaneous caps will be $\frac{1}{2}$-in. shorter than the caps they displace and the delay caps $1\frac{1}{8}$-in. shorter, making it much easier to insert them in the dynamite cartridge. The new caps will have the same explosive charge as the old caps, but will be more dependable, an important safety consideration because of the hazard of misfires.

## Blue Printing Machine

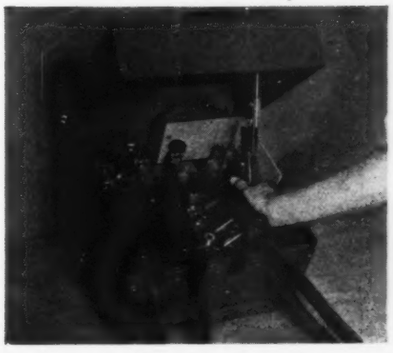
THE C. F. PEASE COMPANY of Chicago has just introduced a new continuous blue printing, washing and drying machine which they claim to be the last



word in fast, high quality performance and modern streamline appearance. The new model 22 utilizes the company's actinic arc lamps which are now controlled through a new patented switch arrangement permitting the lamps to operate at any one of three speeds as desired. The washer is distinctly different and now comprises three horizontal water tanks upon which the paper floats as it is washed, thus eliminating tension wrinkles and distortion. Nine aluminum drums are used to dry the paper evenly and with a flatness never before accomplished (according to Pease claims) yet at a considerable saving in gas or electricity consumption, whichever is used. Potash and hypo application is easily and quickly interchanged by a simple lever control. Production rate of 24 linear feet per minute on d. c. current or 18 linear feet per minute on a. c., is available for large tracings. On smaller tracings the built-in speed permits the use of slower speed blue print paper.

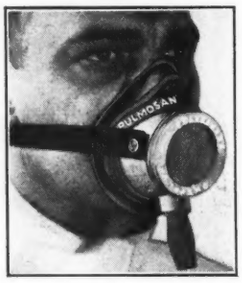
## Interlocking Junction for Trailing Cables

THE OHIO BRASS COMPANY, Mansfield, Ohio, announces development of a new Type B interlocking junction for making d.c. trailing cable connections with the power off. A quick-break switch is interlocked with the case so that the case cannot be opened and connections cannot be made with the power on. Fuse protection is said to be provided for each of the three machine



circuits which the junction accommodates. Provision for a ground circuit is included for additional protection. Trailing cables from machines are clamped in molded rubber hand grips. Each of the three hand grips has three split phosphor bronze plugs, so arranged

*"Light as a Feather" . . .*
**yet SAFE and STURDY!**

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**PULMOSAN R-110**
**DUSTPRUF RESPIRATOR**

Due to its design and construction, the R-110 Dustpruf Respirator has long been famous for extremely light, compact, comfortable, easy-breathing protection against fine dusts. Has Aluminum body, patented rubber face cushion, exhalation valve, replaceable felt filters. Costs less than any respirator approaching its efficiency. Try the R-110 Respirator. Write for details.

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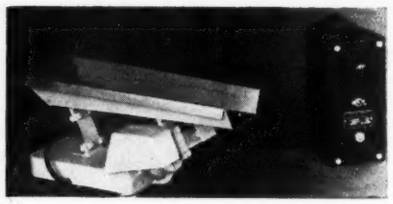
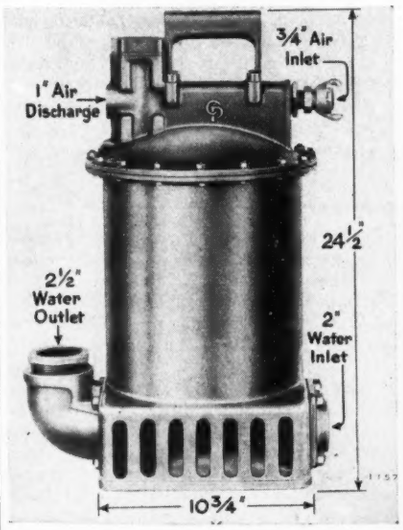
that the plugs cannot be inserted in the wrong machine circuit. One plug makes contact with the positive line, one with the negative line and one with the ground circuit.



**Syntron Company, 510 Lexington Ave, Homer City, Pa., announce this new small vibratory feeder model F-0 for small finely controlled feeds of a few pounds per hour. The feeder is 18 in. long and 3 in. wide and actuated by a pulsating electromagnet.**

## Pump for Drilled Wells

"HI-LIFT" is the trade name given a new pump recently put on the market by the Peerless pump division of the Food Machinery Corporation, 301 West Ave. 26, Los Angeles, Calif. The manufacturer states that the outstanding advantage of the Hi-Lift is in its ability to obtain the maximum capacity from small drilled deep wells (as small as 3 in. in diameter) with lifts ranging from 40 ft. to 1,000 ft. and with small variation in capacity, or pressure, regardless of the height of lift. This feature, together with its greatly simplified design, slow speed operation of 1760 r.p.m. and unusual resistance to abrasion, is said to make the pump particularly suitable for industrial as well as domestic use.

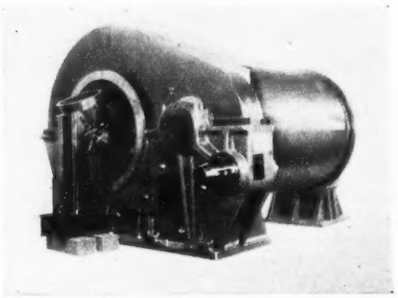



**This new portable air-operated sludge pump announced by the Chicago Pneumatic Tool Company, 6 East 44th St., New York, N. Y., works on the ejector principle. Compressed air enters the air inlet creating a vacuum which sucks water through the inlet valve until a float valve shuts off the air discharge. Air is forced into the drum instead of out the air discharge and the pressure created forces water out in a pulsating flow. Capacities range from 50 ft. to 200 ft. head at 65 g.p.m. to 20 g.p.m. respectively.**

## Compact Welder

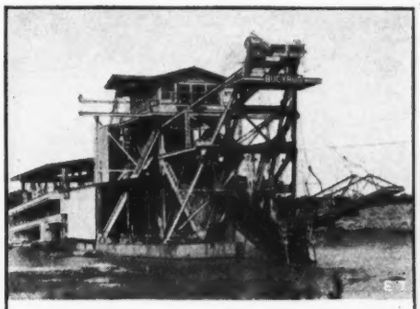
THE HARNISCHFEGER CORPORATION of Milwaukee, announce the new P&H-Hansen Model WA-200 square-frame welder for multi-arc service. The welding unit is said to be compact, simple to operate, it requires less than 3½ sq. ft. of floor space and offers a welding range from 40 to 225 amps.

Retaining advantage made possible by the Hansen patents which cover automatic volt ampere regulation, self excitation and internal stabilization of the welding current, the WA-200 is said to be built along extremely simple lines, having but two major parts—the one-piece frame and the rotating member itself. All attachments such as external exciters, reactors, resistors, rheostats or separate stabilizers are absent. Spring-mounted louvres can be snapped on and off to make periodic inspection of brushes and commutator or for minor adjustments. With the new type of patented frame promoting extremely rigid construction and designed to protect bearings against misalignment and wear, vibration is noticeably absent.



**New large pulverizers applicable to the dry grinding of ores are announced by Kennedy Van Saun Manufacturing & Engineering Corporation, 2 Park Ave., New York. The above unit is 10 ft. in diameter and 15 ft., long built to produce approximately 30 tons per hour of bituminous coal ground to a fineness of 85 per cent through 200 mesh.**

**A new method of glass manufacture yielding products which can be heated to cherry red and then plunged into ice water has been developed in the research laboratories of the Corning Glass Works, Corning, N. Y. Molten iron at 2600 deg. F. is being poured into a piece of ware set on a cake of ice. Five minutes later the glass had settled several inches into the ice without cracking or breaking.**



## Placer Dredges with a Background

Placer dredges built by Bucyrus-Erie have operated successfully in placer deposits all over the world. Your dredge, built by Bucyrus-Erie, will be the best available because of that experience, because of the unequalled facilities of Bucyrus-Erie for designing and building the RIGHT dredge for YOUR particular job. Ask for full information.

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# BULLETINS

**Transmission Belting.** E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa. Folder describes the manufacturer's new specially tanned treaded leather transmission belt. Pp. 2.

**Flotation Machine.** Pan-American Engineering Co., 820 Parker St., Berkeley, Calif. Bulletin PF-1 describes and illustrates by photographs and drawings, including operating performance data, the new Multi-Stage, deep-cell flotation machine (licences under Drake and Gardella patents) placed on the market recently by the company. Pp. 4.

**Underground Cable.** Anaconda Wire & Cable Co., 25 Broadway, New York, N. Y. Folder describes the manufacturer's ANW cables for use in moist locations. Pp. 3.

**Corrosion Prevention.** Technical Protective Coatings, Inc., 3248 Long Beach Ave., Los Angeles, Calif. Booklet is entitled "Encyclopedia of Corrosion, Prevention, Correction, Protection, and Maintenance Coatings." Pp. 28.

**Crushing Equipment.** Universal Crusher Co., Cedar Rapids, Iowa. Form SF-39 is an illustrated folder conveniently indexed for selection of various types of crushing equipment. Pp. 12.

**Electric Ear.** Hardinge Co., York, Pa. Bulletin 42 describes and illustrates application of an electric ear for controlling operation of grinding mills by their sound. Pp. 8.

**Pomoloy.** Pomona Pump Co., Pomona, Calif. Bulletin C-2 describes features of a new type of cast iron used by the manufacturer. Pp. 6.

# INDUSTRIAL NOTES

**Willard H. Cobb,** for the past several years general factory manager, mechanical goods plants, United States Rubber Company, has been appointed general manager of the mechanical goods and general products divisions.

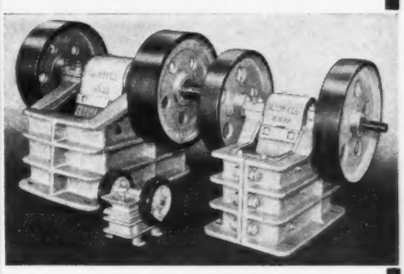
**L. H. Lange,** of the Salt Lake City office of Booth Thompson Division of The Galigher Company, will soon leave for Johannesburg, South Africa, where he will be in charge of the company's offices and laboratory.

**C. W. Nicols, Sr.,** has been elected to the presidency of the Nichols Engineering and Research Corporation, 60 Wall Tower, New York. Mr. Nichols succeeds H. J. Hartley, who resigned recently.

**William R. Elden,** formerly chief engineer of Sauerman Bros., Inc., has opened an office at 11 W 42 St., New York, to handle the sale of Sauerman material-handling and excavating equipment.

**The Mine and Smelter Supply Company,** Denver, Colo., has announced the adoption of a new company seal (shown below) to more clearly identify its products, services and advertisements. The old seal featured the trade-name "Massco."

## HASSELL HIGH CAPACITY JAW CRUSHER



9" x 16"; 8" x 10" Sectionalized
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**Forced-feed-fine reduction**
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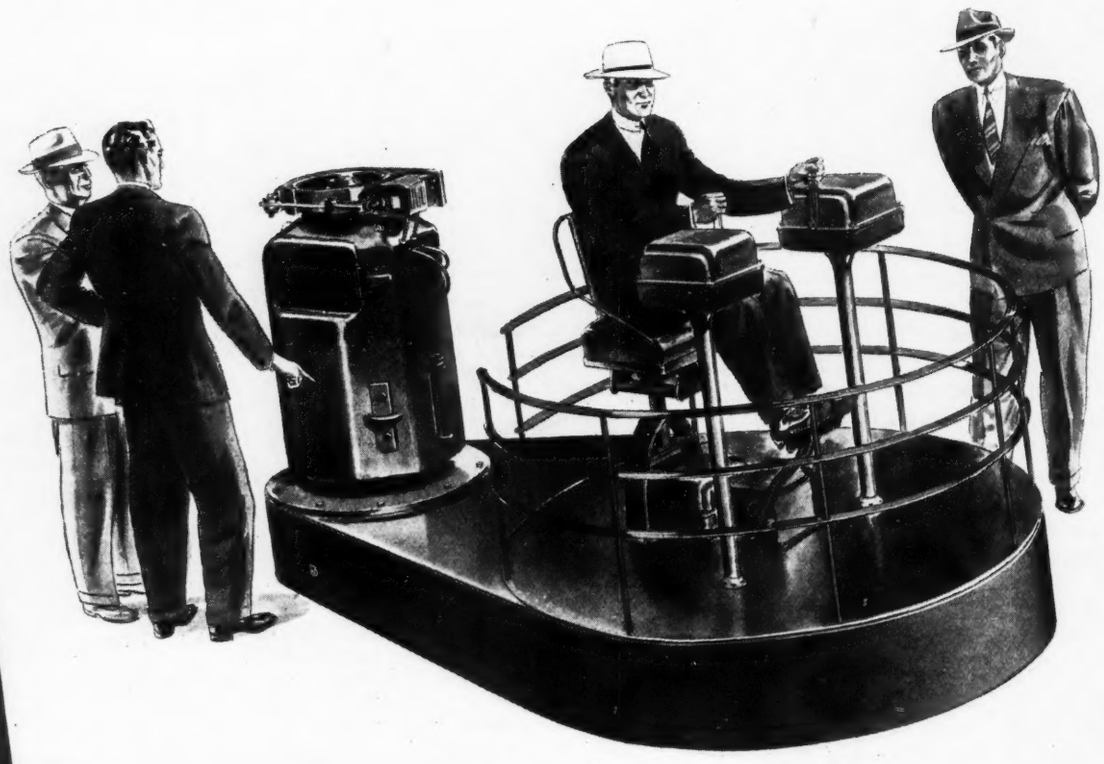
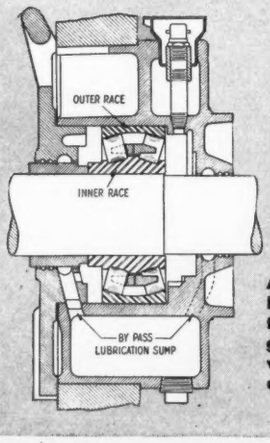
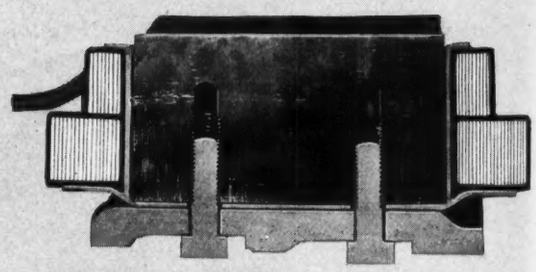


Ride the cab with Westinghouse—get the feel of Westinghouse controls—the ease and dependability of operation. At the Mining Congress—August 28 to 31. Exhibit space 308, 309, 316 and 317.

At left — Vertical type shovel motor, pioneered by Westinghouse, saves space, provides long-life durability of totally enclosed gearing.




At left—Shovel motor housings are dust-tight and arranged for grease lubrication, with by-passes to an excess lubricant pump.



Above — Cross section of motor field coil. Patented construction holds these coils tightly in place and eliminates spring washers and other loose parts. Coils impregnated with high grade insulating varnish, resistant to dust, moisture and oil.

# Westinghouse